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AGGREGATE RESOURCES MANAGEMENT PLAN

-- DRAFT ENVIRONMENTAL IMPACT REPORT --

SONOMA COUNTY PLANNING DEPARTMENT



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SUMMARY

I. Introduction

The Sonoma County Board of Supervisors, on October 17, 1978, directed the Planning Division to prepare a master environmental assessment of gravel mining in Dry Creek and the Russian River from Cloverdale to Wohler Bridge and hardrock mining County-wide. Based on the environmental assessment, a management plan was to be proposed for assuring future aggregate resources while minimizing environmental impacts and land use conflicts.

The study area includes primarily the alluvial flood plains of Dry Creek and the Russian River and some twenty-four existing hardrock quarry sites scattered throughout the County. However, the fact that Marin, Napa, and Mendocino Counties constitute part of the market for Sonoma County's aggregate products has necessitated additional study of regional supply and demand factors.

Rock mining in Sonoma County has a long history. Dating back to the early settlement of the area, rock has been mined from both river and bedrock sources. During the late 1800's, rock from hillside quarries around Sonoma supplied paving blocks for San Francisco, Stockton, and other Bay Area locations. Railroad construction along the Russian River utilized the naturally rounded river gravels present in the streambed. The difficulty and high cost of transporting this high bulk, low-cost commodity dictated that sources of aggregate close to the use be exploited whenever possible.

Over the years, Sonoma County continued to supply rock to both regional and local markets. Projects such as Hamilton Air Force Base, Highway 101 and Richmond/San Rafael and Golden Gate Bridges used Sonoma County rock. Gradually, as population increased, the demand for aggregates increased. The growing urban and rural population became more directly exposed to the mining operations and their environmental impacts, resulting in conflicts between residents and the industry. These land use conflicts became severe when some farmers in Dry Creek filed a lawsuit in 1974 against Sonoma County and several mining operations for damages resulting from the loss of farm lands. The demand for aggregates continues to be high; approximately four million tons in 1978.

II. Description of Existing Environment

Hardrock sources occur almost exclusively in remote areas of relatively steep terrain where large reserves are concentrated in small land areas. In some cases, quarries are located in visually sensitive areas. Erosion hazard is often severe due to steep slopes. Surrounding land uses are primarily grazing or forest. Where residential growth occurs in the vicinity of quarries, conflict with dust, noise, and truck traffic can occur.

Alluvial operations are located either within the stream channel or on flood plain terraces adjacent to the channel. River hydrology and fluvial processes greatly influence and are influenced by these mining activities. Most significant is the relationship between the removal of inchannel gravels and soil replenishment, flood control, bank erosion, riparian vegetation, channel gradient and meander. Land use in alluvial areas is almost exclusively intensive agriculture, with wine grapes and prunes the major crops. Terrace operations which exploit the mineral resource

underlying the flood plain soils directly conflict with agricultural use. Residential uses, in some areas, also conflict with operations in alluvial areas.

III. Aggregate Supply and Demand

Aggregates are used extensively in all types of construction; residential, commercial and industrial, roads and highways, dams, and bridges, etc. Raw materials are processed (washed, screened, crushed, graded, classified, etc.) and sold in unbound form as road base or subbase and in a binding mixture with cement or asphalt for concrete uses. Rock from Sonoma County sources continues to be used throughout the North Bay Region, with approximately 20% of the annual production being delivered for use outside the County. Almost three-fourths of the total production is delivered to the Central and Southern subregions, mainly Santa Rosa, Rohnert Park, and Petaluma.

Future cumulative demand for the market region served from Sonoma County sources is estimated at 62.3 million tons by the year 2000 and 165 million tons over a 50-year period. Estimated Portland Cement Concrete (PCC) demand comprises more than one-fourth, while road materials (asphalt concrete, base, subbase) makes up almost one-half of future aggregate demand.

Three alternative sources of supply are present in Sonoma County. Although most of the current production is derived from alluvial sources in the Northern subregion, each of the hardrock, instream, and terrace sources is available in more than adequate quantities to meet the 50-year demand forecast.

Instream Reserves:	265.0 million tons
Terrace Reserves:	1,066.0 million tons
Hardrock Reserves:	<u>1,075.8 million tons</u>

TOTAL	2,406.8 million tons
-------	----------------------

Furthermore, each of the source types can meet specifications for most uses, although the extent of processing required for some uses may vary by source. According to the geologic reconnaissance and material testing conducted by Cooper-Clark & Associates, Sonoma County has an adequate supply of quality raw materials for aggregate production from hardrock as well as alluvial sources. As a result, non-geologic factors will determine the sources of future supply.

IV. Environmental Impact

Some significant environmental effects result from all mining operations regardless of the source of the material. Alterations in topography and drainage patterns, removal of vegetation, the generation of dust, noise, additional traffic and associated hazards, visual change, increased energy consumption and depletion of natural resources are unavoidable impacts of aggregate operations. However, additional impacts can result from the mining of alluvial sources. These include potential hydrological impacts on streambank stability, channel gradient and meander, bedload replenishment and groundwater supply. Croplands are also threatened by the extraction of both terrace and instream sand and gravel. Major riparian corridors, important habitat for many and diverse species of animals, are affected by alluvial operations along the river as well. Fishery resources are adversely affected by streambed siltation, riparian removal, destruction of pool and riffle areas, and instream crossings. Impacts resulting from the extraction of hardrock sources, on the other

hand, are mostly local in nature.

Impacts on transportation, energy use, and agriculture are relatively less severe for hardrock sources in Sonoma County than for alluvial sources. Because potential hardrock sites are located closer to the major market areas, increased reliance on hardrock will result in an overall reduction in the distances required for hauling aggregate products.

Energy is consumed during the material processing and transportation phases of aggregate operations. Although processing of hardrock is more energy consumptive on a per-ton basis, reduced fuel use for their transportation can result in an overall reduction in energy consumption per ton delivered. Generally, hardrock and alluvial sources consume similar quantities of energy per ton of material when hardrock sources are seven to ten miles closer to the point of delivery.

Impacts on agriculture are also more significant when alluvial rather than hardrock sources are mined. Sand and gravel reserves are located underneath prime soils while hardrock aggregates are found in steep terrain where agricultural uses are primarily grazing. In addition, hardrock operations recover more rock per acre than either instream or terrace operations. As a result, the County's most productive agricultural land will be preserved if appropriate hardrock sources are relied upon for future supply.

V. Alternative Management Plans

Five management options were considered, providing a variety of potential management strategies as well as illustrating

the consequences of heavy reliance upon each of the particular sources. Each of the options is discussed in terms of projected supply and demand by source, the suitability of available materials, and the environmental and economic impacts expected. Comparison of the five options for land commitment, employment, property tax revenues, environmental impact, transportation, processing, agriculture and material suitability reveals that the preferred management option is to rely most heavily on hardrock sources.

VI. Proposed Management Plan

The proposed Aggregate Resources Management Plan calls for a phase-out of terrace mining operations, a reduction in tonnage supplied by inchannel extraction, and increased development of hardrock sources. Reserves for a three-year transition period are proposed for terrace operations, while instream operations will be expected to comply with the revised operation standards as soon as possible. Generally, the availability of instream gravels will be determined by the identified recharge at each site. The location of future instream mining in the study area is limited to the Russian River channel upstream of Healdsburg Dam. No extraction is to occur in either Dry Creek or the Middle Reach below the dam. The proposed plan best reflects the goals and policies of the Sonoma County General Plan while also implementing both the State Surface Mining and Reclamation Act of 1975 and the California Environmental Quality Act.

The Plan includes the establishment of a mineral resource category on the General Plan Resources and Undeveloped Areas Map identifying lands containing mineral aggregates necessary for both a 20 and 50-year supply. It further establishes a mineral resource zoning district for existing operations, a procedure allowing application for

rezoning to MR simultaneously with mining permits, and long-term permits for operations which are consistent with future resource needs identified in the Management Plan. Operation and reclamation standards for mining activities are proposed as amendments and additions to the County Surface Mining and Reclamation Ordinance (Chapter 26, County Code).

The Managed Resources/Open Space Plan supports the Aggregate Use Plan. It provides for protection of riparian and other unique or critical habitats, preservation of scenic and historic resources, buffer zones for air quality and noise impact mitigation, and, most important, preservation of agricultural production on valley soils. The recommendations of the MR/OS Plan are also implemented by proposed operation and reclamation standards.

The Hydrological Change Plan supports and complements the Aggregate Use Plan and sets the stage for recommendations concerning future instream and terrace extraction. The plan also is the basis for reclamation activities in the Middle Reach where terrace operations are to be discontinued. The Hydrological Change Plan also proposes a program for monitoring the hydrological characteristics of the Russian River channel in order to determine the cumulative long-term impacts of inchannel extraction on streambank stability, channel gradient and meander, and gravel recharge. Hydrologic data will be obtained from biannual aerial surveys and processed on a computer model which has been developed by the U. S. Army Corps of Engineers. The model will, within limits, predict bedload scour and deposition in response to streamflow and other variables. Preliminary indications

are that the model can be successfully applied to the Russian River system. In addition, further verification of the model's usefulness under actual hydrologic conditions is scheduled for 1980 and is to be funded cooperatively by Federal water quality "208" funds (pending final EPA approval) through the State Regional Water Quality Control Board.

VII. Management Process

The ongoing management activities include periodic operation inspection and monitoring of all aggregate production activities. A full-time staff position is recommended to oversee the monitoring and enforcement program and handle all permit and reclamation applications. In addition, various consultants will be required to assist the Planning Division and Sonoma County Water Agency in arranging for the aerial surveys, computer facilities, development and processing of data and computations of recharge. Existing zoning enforcement staff will be available to monitor each operation's compliance with permit conditions and reclamation plans. Additional monitoring is proposed for resource supply and demand, energy consumption, transportation, noise, air quality, groundwater supply, and water quality.

I.

INTRODUCTION

BACKGROUND

In October, 1978, the Sonoma County Board of Supervisors directed the Planning Division to undertake the Aggregate Resources Management Study. The Study included a master environmental assessment of the impacts of existing and potential aggregate extraction operations in the valleys of Dry Creek and the Russian River between Wohler Bridge and Cloverdale as well as numerous existing hardrock quarry operations scattered throughout Sonoma County. Based on the environmental assessment and further study of the aggregate industry Countywide, a management plan for future extraction is proposed.

The following issues were identified in the accompanying Study work program, and each has been included in the scope of the Study.

I. Aggregate Resource Issues

- A. A supply of aggregate products of sufficient quantity and quality to meet the projected future demand of Sonoma County's population.
- B. An evaluation of alternative sources of supply.

II. Hydrology Issues

- A. Loss of soil through bank erosion.
- B. Water quality.
- C. Aggregate replenishment in the stream channel.
- D. Water supply, urban and agricultural.

- E. Drainage and flood control.
- F. Groundwater and aquifer recharge.

III. Conservation Issues

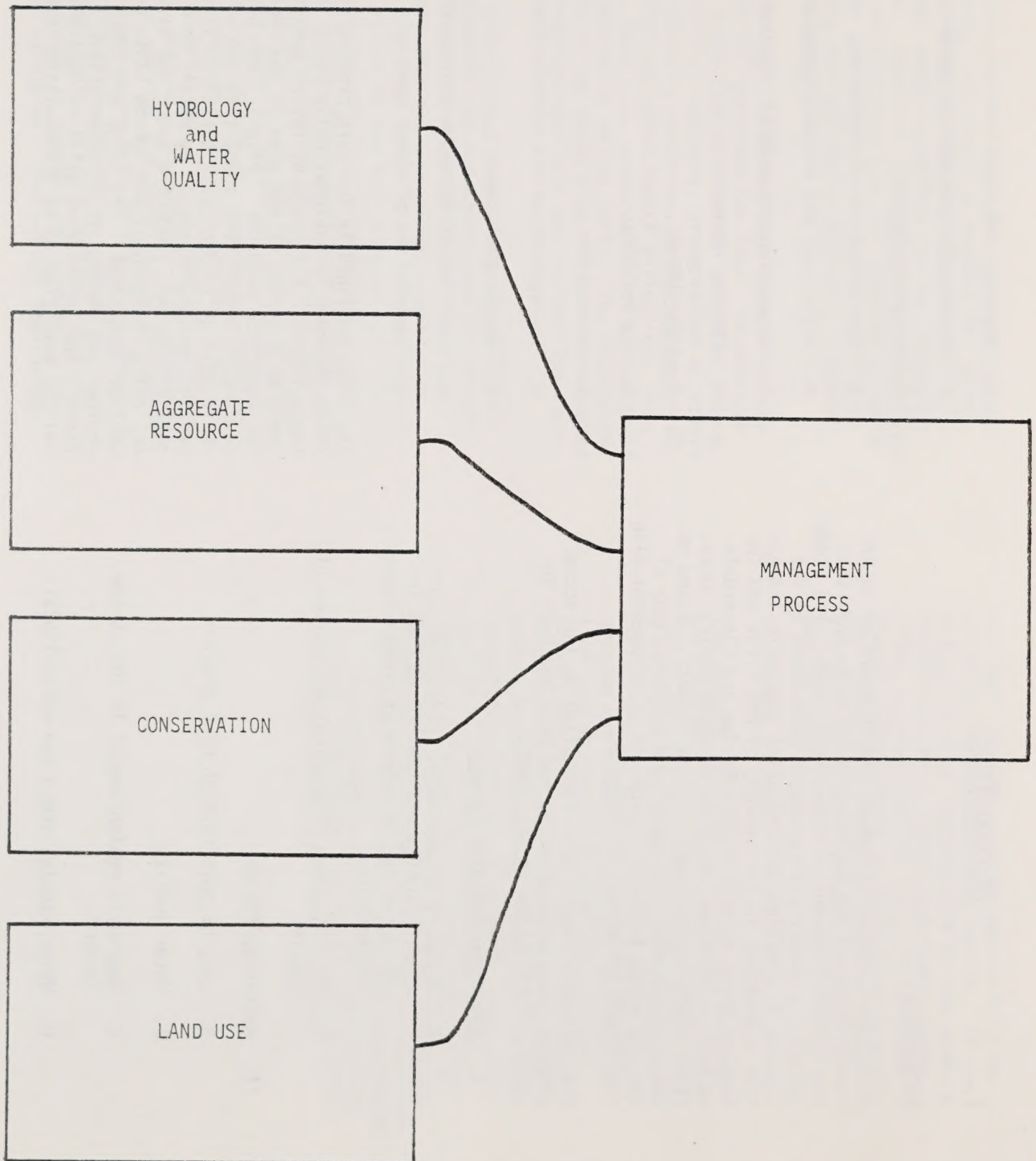
- A. Scenic and visual resources.
- B. Historical and archaeological resources.
- C. Vegetation and wildlife habitat.
- D. Fishery resources.

IV. Land Use Issues

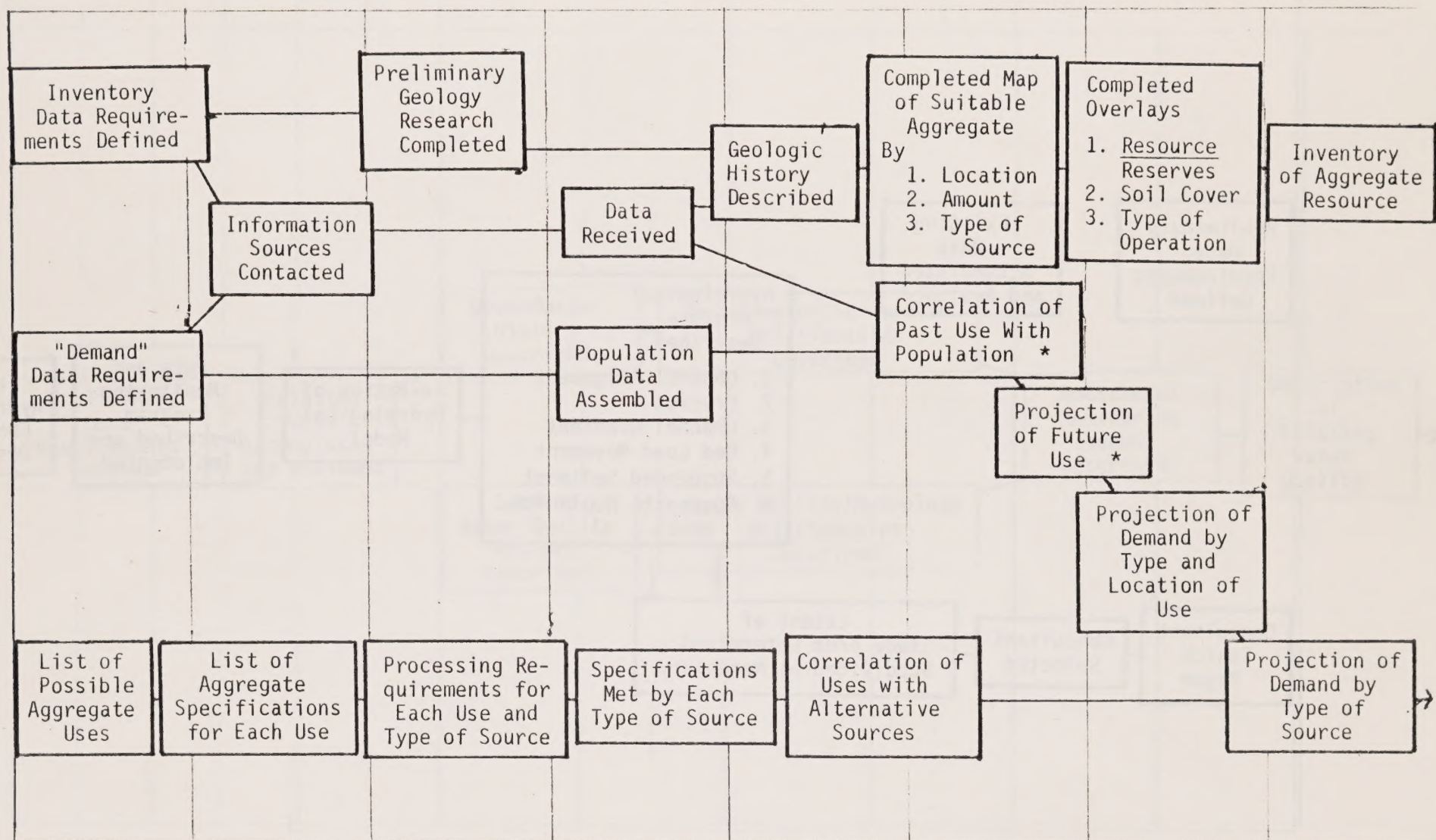
- A. Agriculture.
- B. Recreation.
- C. Transportation and circulation.
- D. Residential uses.
- E. Location of aggregate processing facilities.
- F. Reclamation of mined lands.

The tasks outlined in the work program were undertaken in order to systematically begin to resolve these issues. Estimates of future demand were followed by a survey of the uses of and specifications for aggregate products. Alluvial and hardrock sources of supply were quantified and evaluated for their ability to meet user quality criteria. A survey and reconnaissance of potential hardrock aggregate sources was conducted under the direction of Dr. Rolfe Erickson of the Sonoma State University Geology Department. The study was coordinated with engineering geologists of Cooper-Clark & Associates. Fishery and terrestrial wildlife habitats in the valleys were studied by a consulting team led by

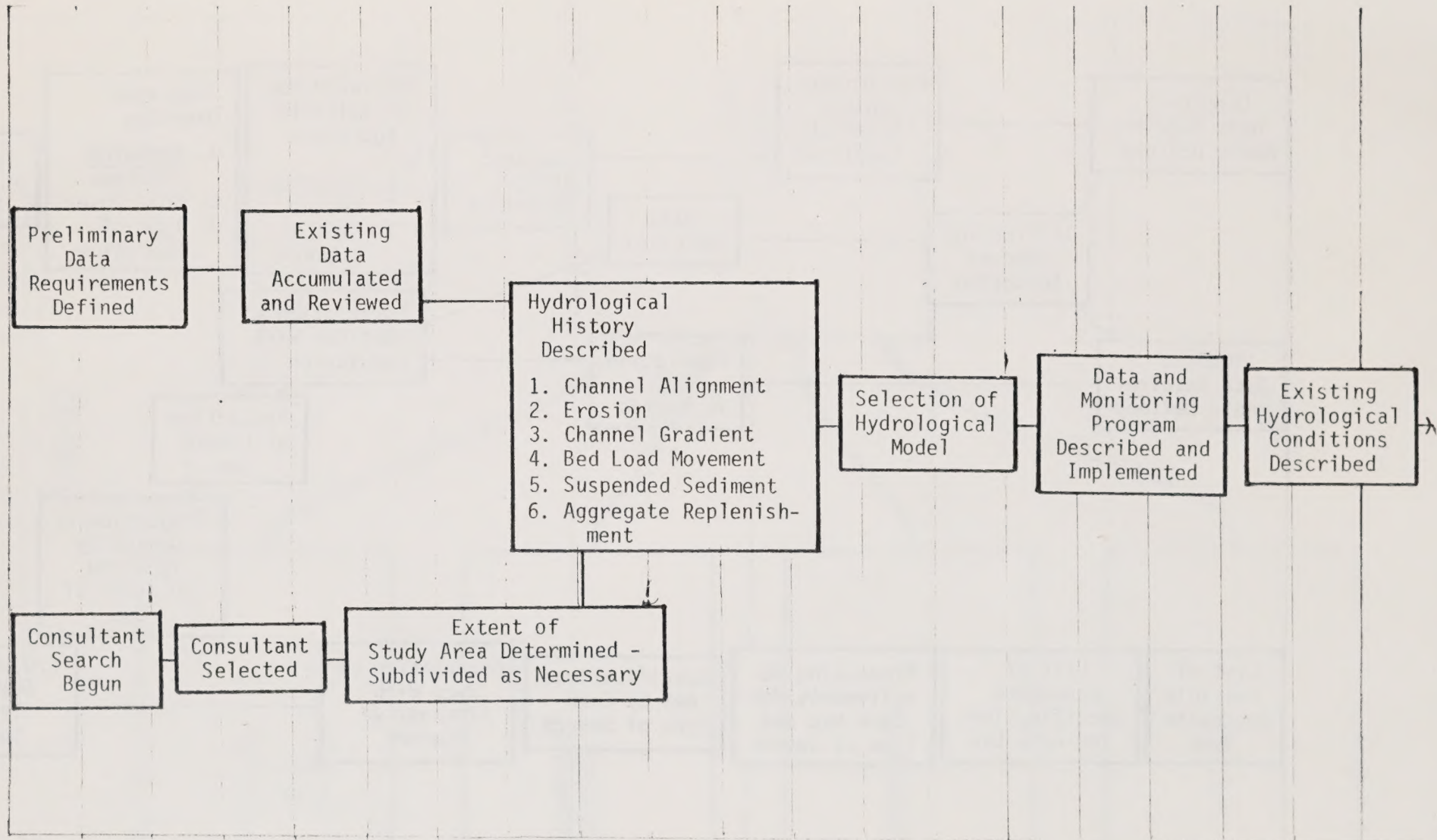
AGGREGATE RESOURCE
MANAGEMENT STUDY
OVERVIEW



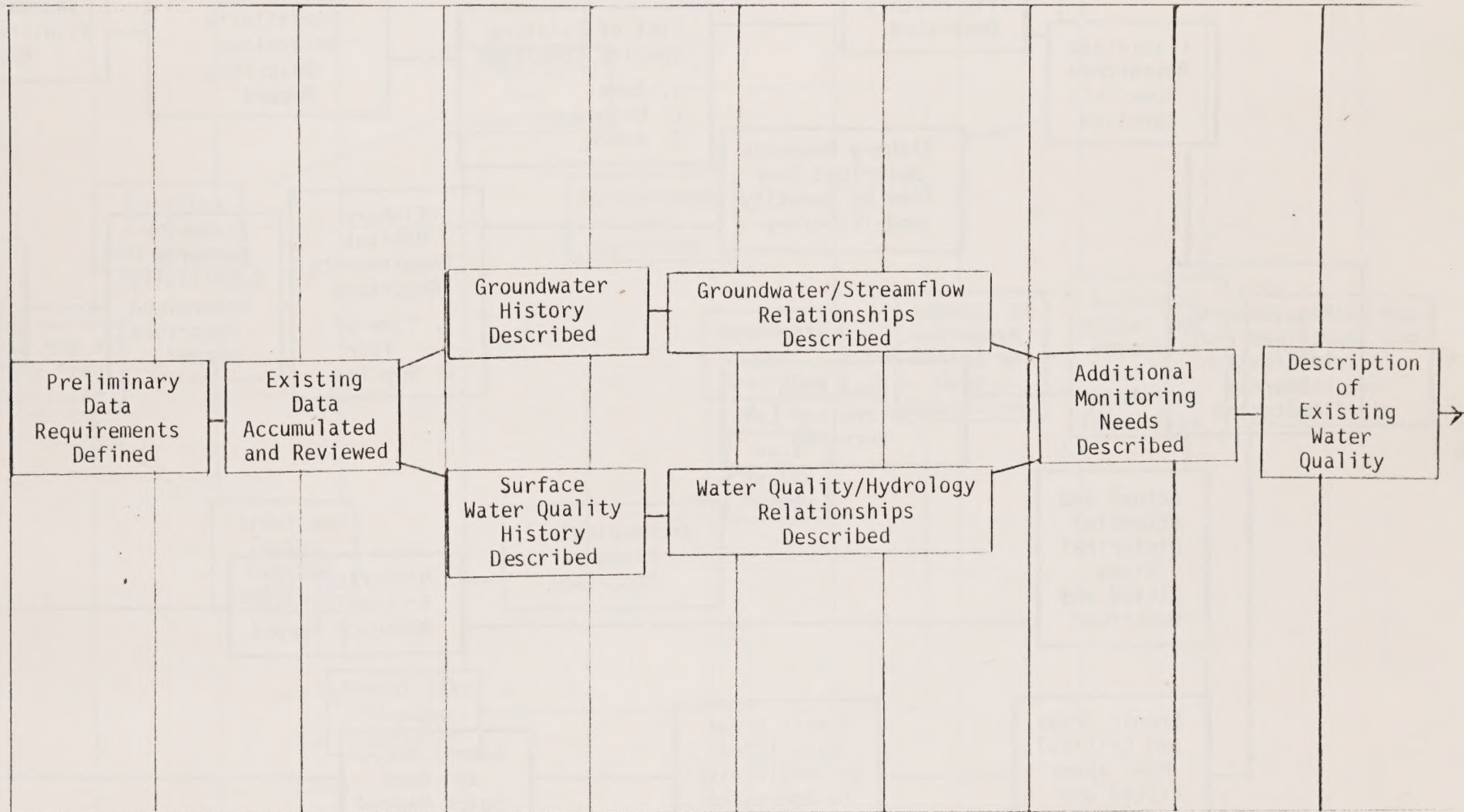
AGGREGATE RESOURCE



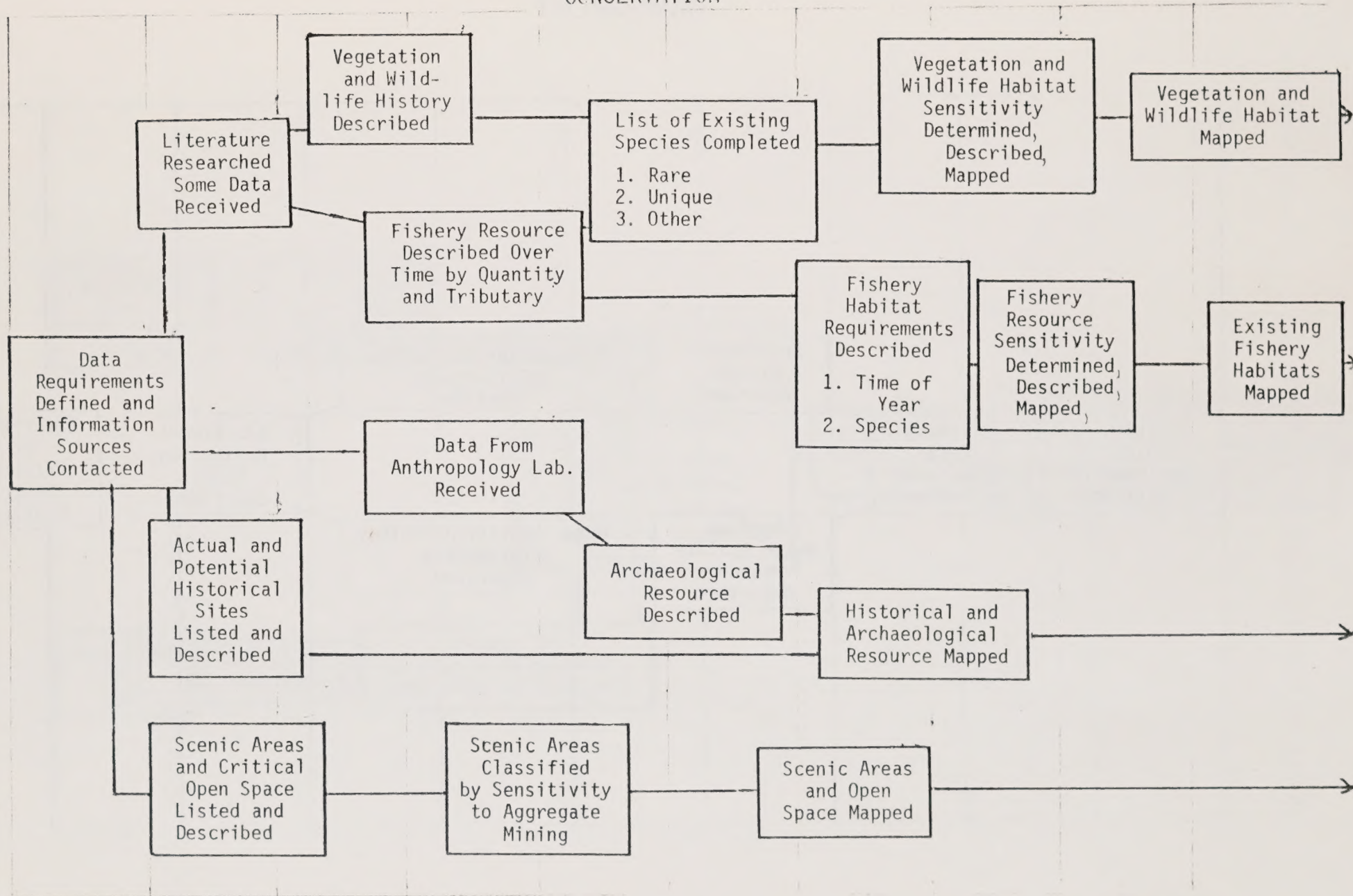
HYDROLOGY



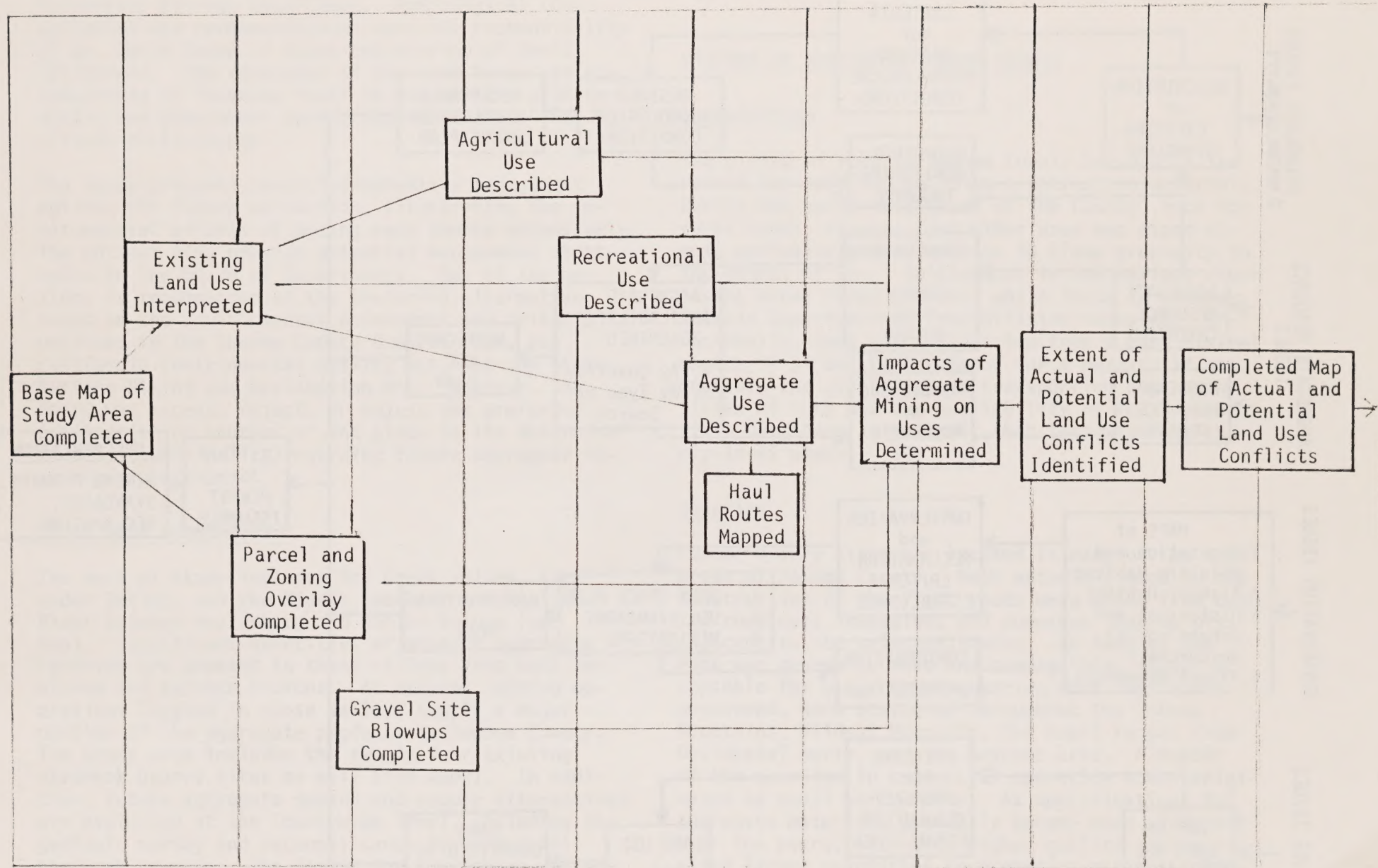
WATER QUALITY



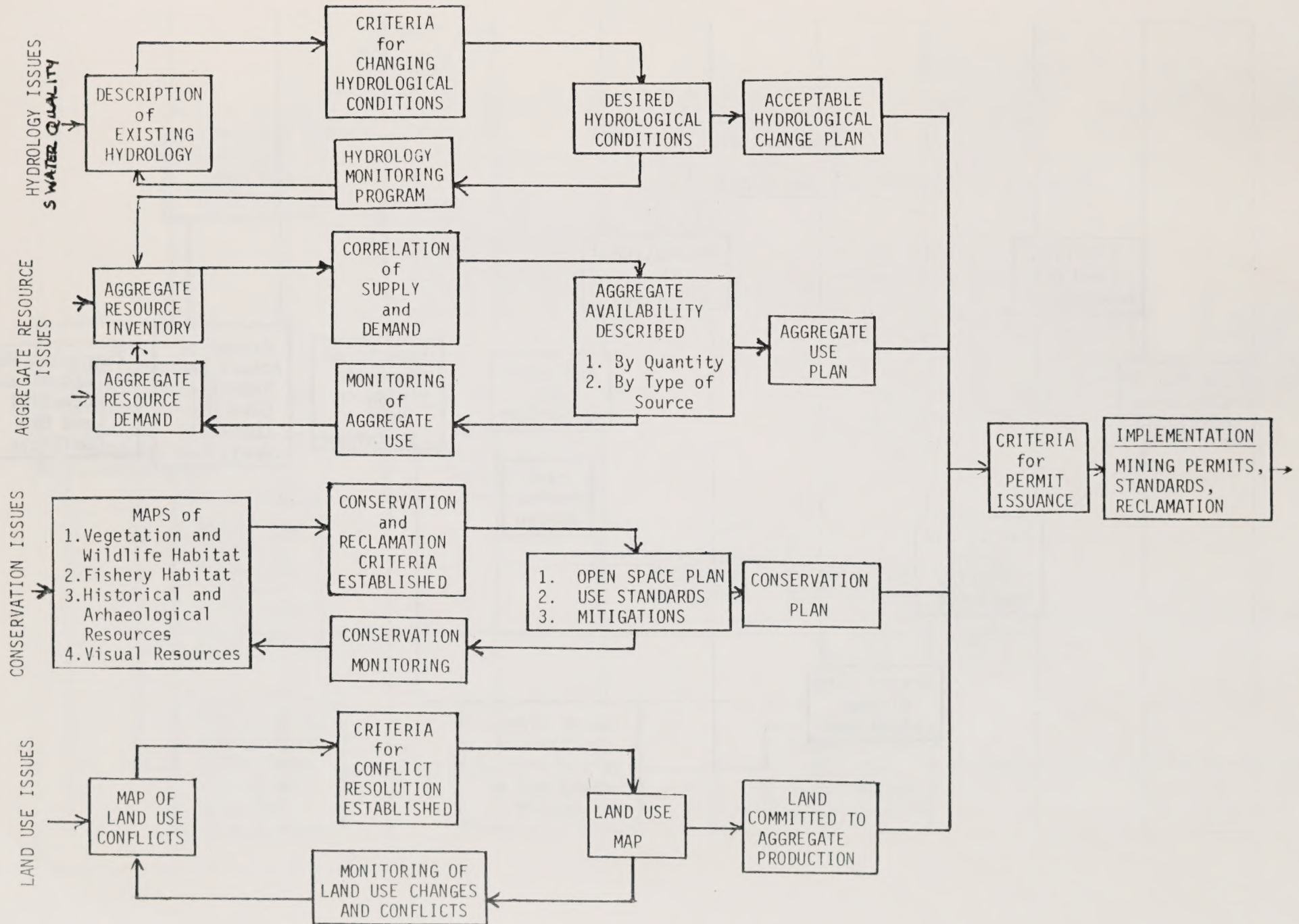
CONSERVATION



LAND USE



12
MANAGEMENT PROCESS



Dr. Philip Northen, Chairman of the Sonoma State University Biology Department. Hydrological consultation and recommendations were the responsibility of Dr. David Storm of Storm Engineering of Davis, California. The remainder of the work tasks was accomplished by Planning staff in cooperation with industry and government agency representatives and citizen participants.

The Study presents several alternative management options for future extraction, illustrating the environmental effects of mining each source extensively. The options also provide potential management strategies to the Board of Supervisors. One of the options is recommended as the preferred alternative based on the environmental assessment and criteria outlined in the Sonoma County General Plan, the California Environmental Quality Act, and the State Surface Mining and Reclamation Act. However, the Board may accept, reject, or adjust the preferred alternative or another of the plans in its determination of County policy regarding future aggregate resource extraction.

STUDY AREA BOUNDARIES

The area of study includes Dry Creek Valley, Alexander Valley, and the Middle Reach of the Russian River between Healdsburg and Wohler Bridge (see map). Significant quantities of mineral aggregate reserves are present in these valleys from both in-stream and terrace sources. At present, mining operations located in these valleys supply a major portion of the aggregate products in Sonoma County. The Study area includes the twenty-four existing hardrock quarry sites as well (see maps). In addition, future aggregate demand and supply alternatives are evaluated at the Countywide level, including the geologic survey and reconnaissance for potential hardrock sources. The demand for aggregates was examined at the regional level, encompassing the North Bay counties as well. Hydrologic issues, in some cases, encompassed the entire Russian River basin

and watershed.

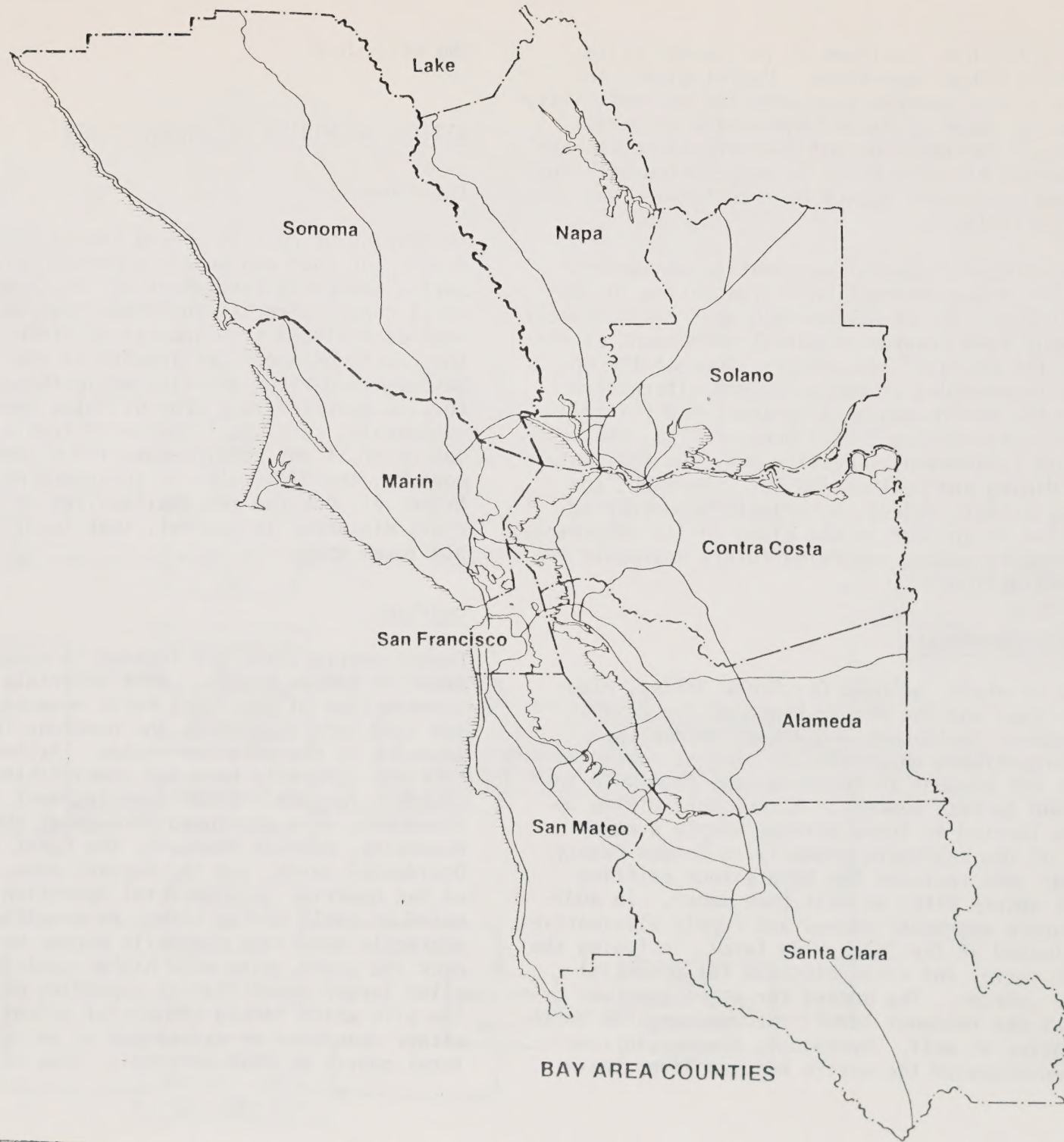
HISTORY OF MINING IN SONOMA COUNTY

Introduction

The mining of rock in Sonoma County began with the demand for road and building construction materials. During the early settlement of the County, rock for rural roads, streets, and other uses was mined almost exclusively from sources in close proximity to the points of use. Settlements in the various river basins mined river gravels, while those in steeper terrain quarried rock from hillside deposits. Occasionally, rock was transported from a more distant source if it met requirements for a particular use. However, the difficulty in transporting huge quantities of rock and the availability of local materials dictated, in general, that local sources supply local uses.

Quarries

Former quarry sites are located in many of the rural areas of Sonoma County. Rock materials used in the construction of the first roads were mined from both the road cuts themselves and numerous "borrow pits" adjacent to the selected routes. As long as the rock was generally hard and compactible, it was acceptable for use. Other quarries, most long since abandoned, were scattered throughout the Sonoma Mountains, Wildcat Mountain, the Coast ranges from Occidental north, and the Geysers area. A number of the quarries in commercial operation today originated as small borrow pits. As specifications for aggregate materials gradually became more stringent over the years, pits with higher quality rock supplied larger quantities to expanding markets. Borrow pits which lacked commercial potential were either abandoned or maintained as an occasional local source of fill material. Some of the older



Lake

Sonoma

Napa

Solano

Marin

Contra Costa

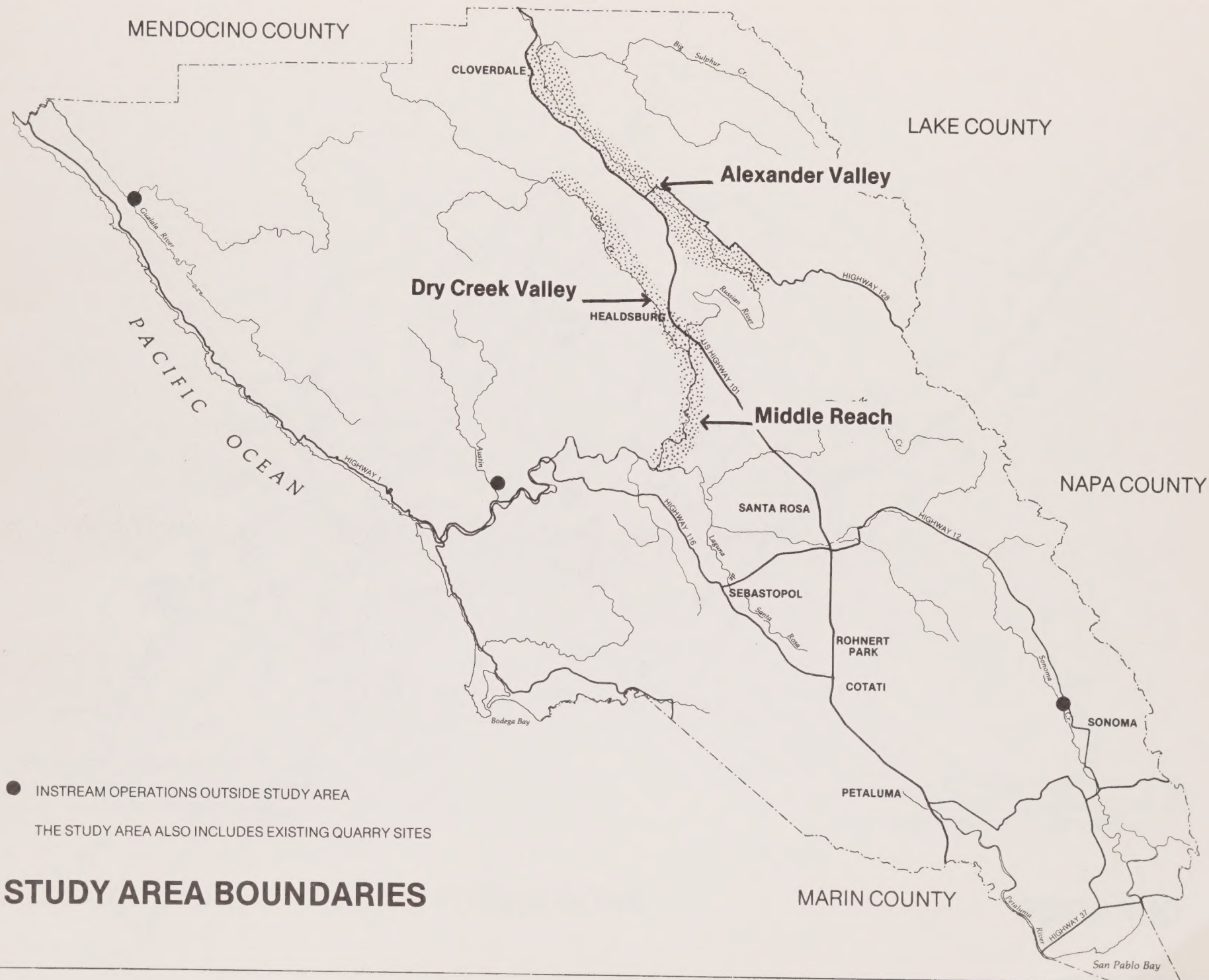
San Francisco

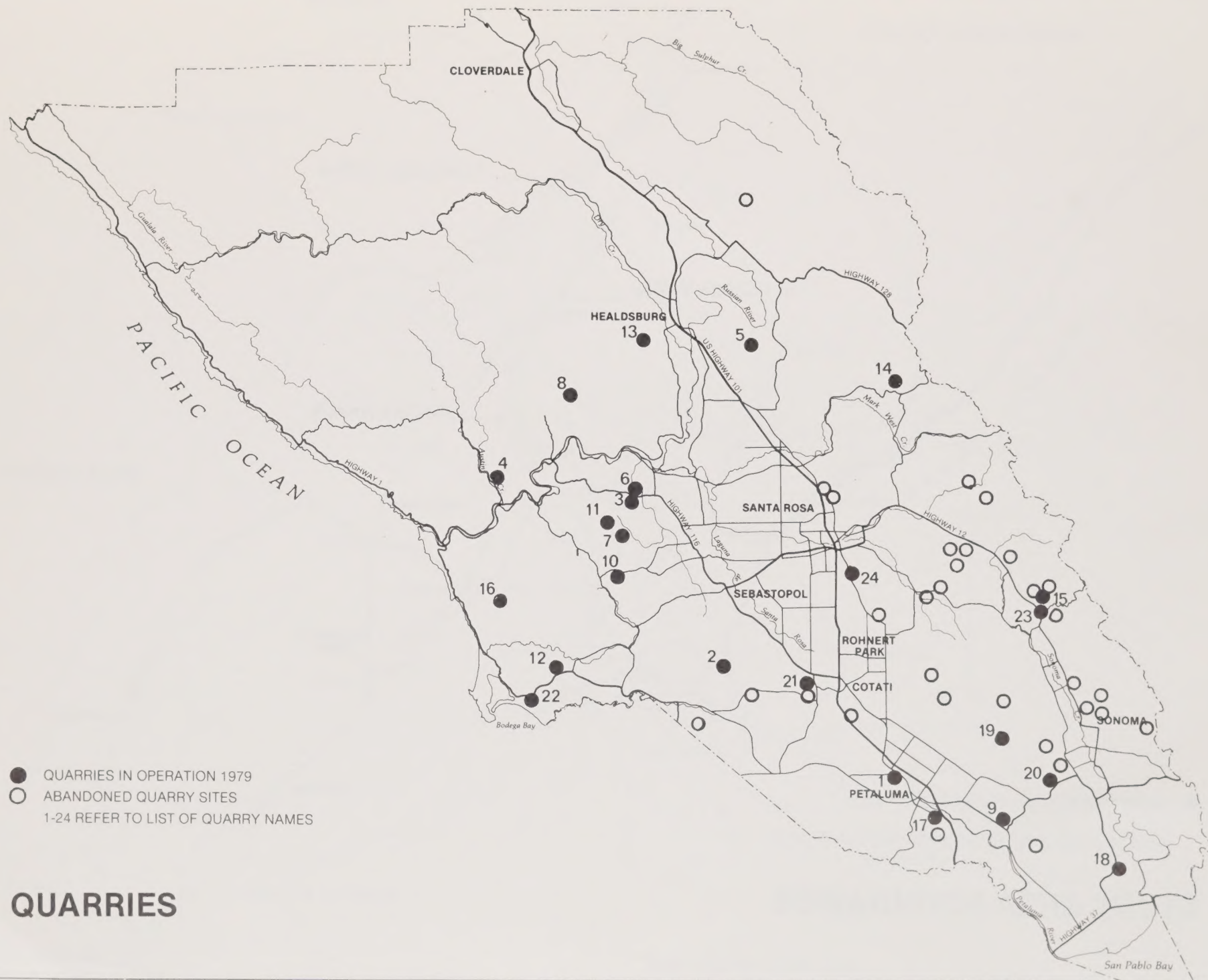
Alameda

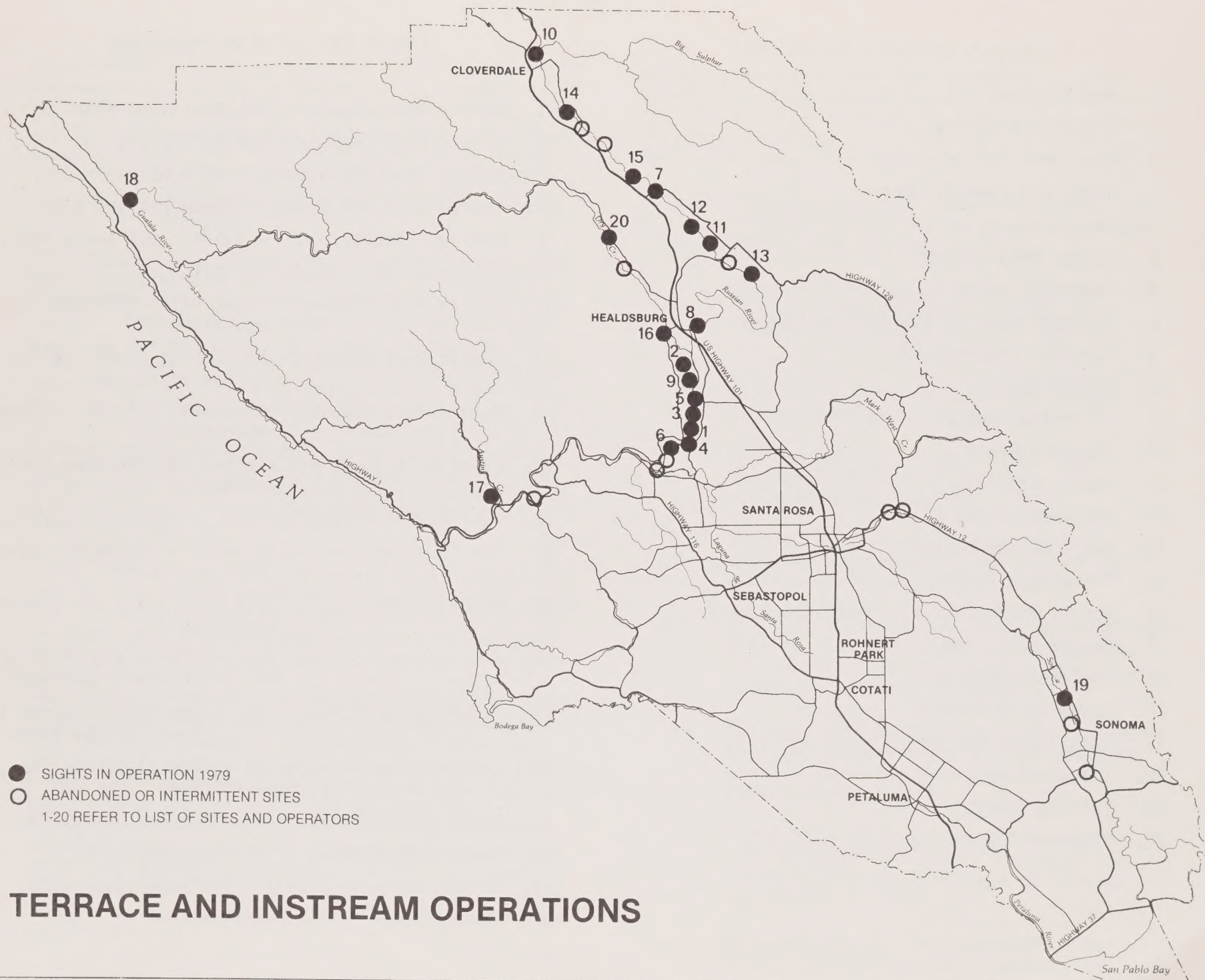
San Mateo

Santa Clara

BAY AREA COUNTIES







- 10) Zaney Gravels Quarry: produced crushed stone for grading and paving from Taylor Mountain south of Santa Rosa on Petaluma Hill Road.

The following quarries produced flagstone or colored building stone:

- 11) Candy Rock Quarry north of Sonoma in Nun's Canyon near Highway 12.
- 12) Gerberding Quarry north of Trinity Road.
- 13) Gordenker Quarry on Bennett Mountain west of Lawndale.
- 14) Johnson Quarry near Trinity Road.
- 15) Rainbow Quarry east of Agua Caliente.
- 16) Valley of the Moon Quarry (Cabrol) south of Trinity Road. This was one of the largest flagstone operations at the time and had been ongoing since 1928.

As Sonoma County's population began to increase during the 1950's, the use of river channel materials increased with the demand for concrete and road base aggregates. Quarries continued to supply rock for construction purposes (Hein Brothers, for instance, produced rock for the Petaluma portion of Highway 101), but increasingly stringent specifications continued to limit the use of most of the existing quarry rock for road subbases and fill materials. Several factors contributed to their inability to compete with river materials, including material quality, processing costs, and abundant and inexpensive fuel for transporting rock over long distances. When, in the early 1960's, the Sonoma County Department of Public Works substantially revised its specifications, the existing quarries could rarely meet specifications for other than subbase or fill materials without a substantial investment in processing

operations.

In recent years, though, quarries have begun to compete in the markets for road base, asphalt concrete, and other uses which, for many years, were supplied primarily by river gravels. Operations such as Nun's Canyon Quarry are supplying rock for decorative purposes. On occasion, quarry materials are imported from outside Sonoma County. The McNears Point Quarry on the Tiburon Peninsula in Marin County has provided riprap rock for bank and road cut stabilization, and the Napa Quarry is a frequent supplier of road materials for Sonoma area projects.

River Gravel Mining

The use of river sand and gravel has been extensive for many years. Since river gravels occur naturally in rounded form and are generally hard and durable, they have found application in many uses for which aggregate quality is stringently controlled. Most of the mining of river materials in Sonoma County has taken place in the middle reach of the Russian River between Healdsburg and Wohler Bridge. At one time or another, though, virtually the entire stretch of the river channel has been mined, including Alexander Valley and lower river reaches. Other County streams have also been mined, including Dry Creek, Santa Rosa Creek, Sonoma Creek, and the Gualala River. The following section describes the history of mining specifically within the Middle Reach, Alexander Valley and Dry Creek basin study areas.

Middle Reach

Gravel mining in the Middle Reach of the Russian River south of Healdsburg has been ongoing since the middle 1800's. Using available Chinese labor during the 1870's, the San Francisco and Northwestern Railroad Company mined gravels by shovel near the present Healdsburg processing plant of Basalt Rock Company (River Mile No. 32). The railroad

used the river aggregate as ballast under its local rail lines. John Grant, whose father had earlier leased his land to the railroad company, established his own grading plant a few hundred yards downstream of the present plant in 1906. The Russian River Gravel Company, as it was known, was operated by Grant and his son from 1906 to 1931 when it was purchased by the Basalt Rock Company.

During the 1930's, Basalt used a crane to excavate gravels from the riverbed upstream of the railroad bridge (River Mile No. 32.5). Then, with the purchase of the "3W" crane in 1940, mining began in the area south of the bridge to approximately one-half mile downstream of the mouth of Dry Creek (River Mile No. 30). Aerial photos taken during this period show that mining had occurred below the Dry Creek confluence as early as 1942. Access along this reach was accomplished by the construction of a road/levee along the western bank of the river and across Dry Creek. The levee served other purposes as well. It provided some protection from flooding for the agricultural lands in the vicinity. Furthermore, the levee made available for farming additional lands which previously had been part of the stream channel and its associated riparian growth.

During the 1930's and 40's, building activity began to increase substantially in Sonoma County. Gravel operations were called upon to meet the increasing demand for aggregates for various uses.

The Mirabel Sand and Gravel Company, operated by Simon Camgros, produced sand and gravel from the river near Mirabel Park beginning in 1927. Nine years later, W. Carter Maxwell began producing similar materials approximately 1.5 miles upstream of the Camgros operation. Then, in 1942, Siri and King leased a portion of beach near Monte Rio and continued to excavate gravels from a site that had been worked steadily since 1900.

Santa Rosa and Sonoma Creeks were mined during this

period. In Santa Rosa Creek, the Onsrud Construction Company operated a gravel pit and washing plant about three miles east of Santa Rosa until 1948. In the same vicinity, the Joseph & DePaul Company had a gravel pit and asphalt mixing plant. Sonoma Creek from Agua Caliente to its mouth was a source of construction gravels. J. P. Serres had a screening plant near Agua Caliente up until the late 1940's (later reopened). L. J. Wrobel had a small pit and screening and washing operation on the east side of the Creek near Sonoma. Finally, C. E. Palmer sold creek-run gravels for fill from a bar 2½ miles south of Sonoma.

Projects such as the Golden Gate and Richmond-San Rafael Bridges, Hamilton Air Force Base and the 101 freeway were more common. While Basalt continued to excavate gravels from Healdsburg to Dry Creek to depths of 30-32 feet below water level, other firms also began mining operations in the Valley in the 1950's. Windsor Sand and Gravel established a mining operation near the south end of the Valley along Eastside Road around 1953 (River Mile No. 25). Later purchased by Kaiser Sand and Gravel, the in-stream operation took place over a 1½ mile stretch just upstream from Wohler Bridge. Immediately north of the Windsor plant, Walt Doyle began mining concrete aggregates from the east side of the stream channel (River Mile No. 26). Hein Brothers also began operating in the Russian River near Windsor River Road during the late 1940's (River Mile No. 28).

Thus, in the late 1950's, gravel mining was extensive in the middle reach of the Russian River. In-stream mining progressed further south from Healdsburg as the Basalt Rock Company brought in a larger shovel ("7W") that had the capability to mine 55 feet below water level. The river from below Dry Creek to the "Doyle" plant was mined to this depth during the late 1950's and early 1960's to provide aggregate for such purposes as the construction of the 101 freeway from Santa Rosa to Healdsburg. The southern half of the present west bank levee (River

Mile Nos. 27-29) was constructed from 1957-1958. Coupled with the Hein Brothers and Windsor operations, virtually the entire stretch of the Russian River between Healdsburg and Wohler Bridge was subject to gravel extraction at the time.

The major occurrence in the middle reach during the 1960's was the conversion of instream mining operations to the alluvial terraces immediately adjacent to the streambed. Basalt had been mining a small parcel on the west bank of the river below Dry Creek on occasion since 1955, but, in 1967, purchased a portion of the Grace Brothers Ranch and began full scale operations with the "7W" shovel just west of the levee. At the same time, the "3W" shovel was moved further downstream to the Doyle Plant (purchased from Walt Doyle in 1960) to begin work on the east bank terrace. Kaiser also pulled out of the streambed and began mining in the terraces to the east of their instream operation and at another site further north (River Mile No. 27), thus forming their "south pit" and "north pit", respectively. Hein Brothers Company, a smaller operation, also began mining from the terrace along the east bank of the river immediately upstream of Kaiser's north pit (River Mile No. 28).

In the 1960's as population growth began to accelerate and the demand for construction materials rose, mining near Wohler Bridge (River Mile No. 23) was also increasing in intensity, although it remained instream for a while. Both Joe Cook near Mirabel and Marshall Maxwell north of the bridge were conducting mining operations during this period. The Arthur B. Siri Company took over the Maxwell operation in 1966 and continued mining in that location during the 1970's with both instream operations near the Wohler pumps and a terrace excavation south of the bridge on the east bank.

In recent years, the terrace operations have been predominant in the Middle Reach. Basalt continues to supplement its terrace gravels with material from

the river below the mouth of Dry Creek and occasionally excavates from the area above the railroad bridge. However, the bulk of aggregates mined in the Middle Reach comes from terrace deposits.

Soiland Co., Inc. has taken over operations on the MacMurray Ranch near Wohler Bridge where a terrace mine is in operation along the east bank of the river (River Mile No. 23.5). Kaiser Sand and Gravel continues to remove gravels from both north and south pit areas. Basalt is mining terraces at the Doyle plant and the former Grace Brothers Ranch near Dry Creek. Quarry Products, Inc. has taken over the instream operations of the Hein Brothers and moved onto the terraces.

Dry Creek

Gravel extraction in Dry Creek also began prior to the turn of the century. Most of the extraction has occurred in the vicinity of Westside Bridge (Dry Creek River Mile No. 2). Jim Taylor began a horse and wagon operation in that area before 1900, supplying local consumers and providing rock for the construction of the Healdsburg Avenue Bridge. His son, Harvey, continued mining on a small scale during the 1920's and 1930's, including a contribution to the construction of Westside Bridge.

During World War II, Harvey and his son, Malcolm, shipped ballast material from the north side of the bridge. They were joined by others as they continued to mine at a slower rate following the war. The Soracco Brothers operated a small scale operation on the south side of the bridge during the 1950's and early 1960's. They were followed by a string of contractors: Trudell, Carteroli, McKuen, etc., in that location until Dave Bramham took over in the late 1960's. Under Bramham, the "Dry Creek Sand and Gravel Company" mined south of the bridge until 1976, when the business was sold to the present owner, Soiland Co., Inc. The city of

Healdsburg also mined in that area during construction of the County yard.

On the north side of the bridge Malcolm Taylor ran the "Healdsburg Sand and Gravel" operation until Reiman and Garrett leased it from him in the late 1960's. Finally, in 1973, Soiland Co., Inc. took over the lease. Reiman and Garrett still maintain a ready-mix firm next door, however.

With the exception of the wartime mining operation of the Taylors, the extent of mining in the Westside Bridge area had been minimal, according to both residents and operators in the area, until the late 1960's. In recent years, as demand for construction materials has increased Countywide, the rate of removal has also increased. The Soiland operation extracted relatively large quantities during the middle 1970's.

Other portions of Dry Creek have also been mined in past years. George Brown runs a small river operation several miles upstream of Westside Bridge (Dry Creek River Mile No. 9.4), supplying local farmers and others with rock for roads, driveways, etc. Since 1963 the County of Sonoma has removed material at times from the Lambert Bridge area (Dry Creek River Mile No. 7) for various public projects. Dry Creek gravels have also been used for the bank protection efforts undertaken by creekside residents since the increase in stream bank erosion began during the 1950's.

Alexander Valley

Historically, mining in the Alexander Valley has primarily served local needs. However, some major regional projects have also used Russian River gravels from this area. These include the Coyote Dam, the Santa Rosa Air Station runway, Richmond/San Rafael Bridge, and sections of Highway 101.

Mining of river gravels between Chianti (River Mile

No. 56) and Cloverdale (River Mile No. 62) occurred during the construction of both the Northwestern Pacific Railroad's line and Highway 101 in the early 1920's. During that same period, many contractors used river materials for various local projects. A few years later, several of the lumber firms in the Cloverdale area began extracting local gravels for the expansion of their mills (River Mile Nos. 60-62). In at least two cases, the mill sites were located in the old river channel and subsequently protected from flood waters by a levee system.

Since World War II, mining in the Chianti-Cloverdale reach has provided aggregate for the 101 freeway, the Cloverdale Airport, and other local road projects. The Italian Swiss Colony winery (River Mile No. 58) mined gravels from the river for their own use in the late 1940's. Paul Cavallo started Cloverdale Readymix north of the Crocker Road Bridge (River Mile No. 62.5) in the late 1940's and they have since continued to supply materials both locally and to the Geysers area under several ownerships.

Mining during the 1960's and 1970's has included several single project operations. The Asti Winery site was mined for gravels used in Highway 101 construction by the Guy F. Atkinson Company. The Gordon Ball Company removed gravels from another site near Chianti for the Geyserville portion of Highway 101. Finally, aggregate materials for construction of the airport south of Cloverdale were extracted from the gravel bar at that site. Other than the Cloverdale Readymix Company, however, no commercial operations have been ongoing in recent years north of Chianti.

Mining in the southern portion of the Alexander Valley (River Mile Nos. 43-54) also began extensively during the construction of the rail line and highway during the 1920's. Two sites in particular have supplied gravels for various projects over the years.

The gravel bar at the mouth of Sausal Creek (River

Mile No. 44.5) has been mined almost continuously since the 1900's when Sonoma County extracted gravels for local road construction. A series of private contractors have held leases on the bar ever since. Harold Groom, Inc. holds the present lease, marketing gravel materials in both Sonoma and Napa Counties.

Since the 1940's, the Geyserville Bridge site (River Mile No. 52) has been an important supplier of rock under the ownership of the Basalt Rock Company. They sold river aggregate for a number of projects in Sonoma and Mendocino Counties. Part of the sub-structure of the Richmond-San Rafael Bridge and the Santa Rosa Air Station runway were constructed with Geyserville gravels.

Basalt also supplied aggregates from this site to the Coyote Dam in the middle 1950's. Following the completion of the dam, the Army Corps of Engineers embarked on an effort to maintain bank stability in the Alexander Valley. As a result of this program, local gravels were used for a number of riverbank levees constructed between 1958 and 1963. Since 1963, the Sonoma County Water Agency has continued to use river gravels for levee maintenance and other flood control purposes.

In recent years, several gravel extraction operations have been ongoing in the Alexander Valley. Harold Groom, Inc. recently received a County Use Permit to mine another bar several miles to the north of his Sausal Creek site (River Mile No. 49). Paul Cavallo Trucking has mined another bar nearby that is under lease to Soiland Co., Inc. (River Mile No. 47.5). Basalt, in addition to its periodic extraction near Geyserville Bridge, also mined the bar immediately south of Jimtown Bridge (River Mile No. 46) during freeway construction south of Geyserville in the mid-1970's. Approximately one mile north of Geyserville Bridge, the Geyserville Sand and Gravel Company (Piombo Corporation) has conducted a mining operation since 1972 (River Mile No. 54), supplying aggregates for such projects as the Warm Springs Dam Fish Hatchery.

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II. A.

DESCRIPTION OF EXISTING ENVIRONMENT: EXISTING HARDROCK OPERATIONS

Hard rock quarries in Sonoma County are located in areas of high topographic relief. Mining operations consist of the removal of soils and weathered overburden followed by the extraction and processing of the hard unweathered bedrock. Various types of processing operations are found at most of the twenty-four quarry sites, though some are "borrow pits" where rock is sold in an unprocessed form. Processed quarry rock is presently used primarily for various road materials as "bank run" or mixed with asphalt. Other uses include fills, drain rock, riprap, and decorative materials.

The accompanying chart lists the borrow pits and quarries in Sonoma County by name and provides a quick-reference description of the natural and cultural environments of each site. Also included are the County General Plan and relevant Specific Plan designations for each quarry, with a brief description of individual site characteristics. Each site is mapped in Section VI.

BORROW PITS

(1) Arfsten

Geology: Pliocene marine and non-marine sediment
Product: Fill, subbase
Location: Gossage Lane, Petaluma

The Arfsten Quarry is a small sand pit near downtown Petaluma. The excavation occupies about three acres. Access is via Gossage Lane and Petaluma Boulevard North. Surrounding uses are residential and commercial in a fairly urbanized

area. Immediately downhill from the property are some small commercial uses which are affected by sediment carried from the site during winter rains. Haulage of materials along Gossage Lane has the potential to increase truck traffic and noise impacts. The County General Plan designates the site as part of the urban expansion area of the city of Petaluma. The site is designated as "low-density" residential on the Petaluma General Plan Map and "agriculture/open space" on the Environmental Design Plan Map.

(2) Bohan & Canelis

Geology: Franciscan Formation
Product: Fill materials
Location: Austin Creek Road, Cazadero

The one-acre quarry is located at the same site as Bohan & Canelis' instream operation in Austin Creek and is secondary to it in terms of the amount of material extracted. Slopes are in excess of 30% and crop suitability of the soils is limited. The vegetation is coniferous forest. Redwoods and riparian growth parallel Austin Creek adjacent to the quarry site.

The area abounds with summer resort cabins and a few year-around residences. To the east of the site is open land. The General Plan designates the site itself as undeveloped on the Land Use Map, though surrounding parcels are designated as River Resort. The quarry lies within the "Managed Resource: Timber" designation on the Resources and Undeveloped Map, and nearby Cazadero Highway is designated as a scenic corridor on the Critical Open Space Map.

(3) Chenoweth

Geology: Franciscan formation
Product: Fill materials, subbase

TABLE II. A-1

ENVIRONMENTAL DATA

BORROW PITS

	Slope	Geology	Soil Class	Vegetation	Ground-water	Hydrology	Fire Hazard	Surrounding Uses
1) ARFSTEN	0-5%	PMN	3	Urban	2			Urban
2) BOHAN & CANELIS	+30%	FR/QS	6+	CF	1	FH,PS,AR		Open Land
3) CHENOWETH	+30%	FR	6+	CF	3		X	Open Land
4) GHILOTTI	15-30%	PMN	6+	GR	2			Grazing
5) GRAHAM	15-30%	PMN/FR	2,6+	CF	5			Grazing
6) GREEN VALLEY	+30%	FR	6+	MF	3/5		X	Logging
7) HAGEMANN	15-30%	PMN	6+	GR	5			Grazing
8) PASSALAQUA	15-30%	FR	6+	CF	5			Grazing
9) SPALETTA	15-30%	SV	6+	GR	3/4			Grazing
10) STAGE GULCH	15-30%	SV	6+	GR	4			Grazing
11) TRANSCENTURY	15-30%	FR	4,6+	BR	3/5			Residential

QUARRIES

1) BLOOMFIELD	15-30%	PMN	4,6+	GR	2/3			Grazing
2) BLUE ROCK	+30%	FR	6+	MF	5		X	Open Land
3) BROOKS	15-30%	SV	6+	GR	3/5		X	Grazing
4) CANYON	+30%	FR/QS	2,6+	MF	2	FH,PS,AR	X	Open Land
5) CINNABAR	+30%	TLS	4,6+	MF	5	PS,AR	X	Open Land
6) INMAN	15-30%	FR	6+	MF	5	PS	X	Open Land
7) MARK WEST	+30%	FR	6+	MF	4		X	Open Land
8) NUN'S CANYON	+30%	SV	6+	BR	1			Poultry
9) QUARRY PRODUCTS	5-15%	SV	6+	Urban/GR	2			Urban
10) SONOMA ROCK	0-5%	SV	2,6+	GR/WL	2	W,FH		Grazing
11) STONY POINT	15-30%	PMN	3,6+	GR	2/5			Grazing
12) TRINITY	15-30%	SV	3,4	GR	1			Poultry
13) ZAMARONI	+30%	SV	6+	MF	4			Open Land

KEY TO CHARTGeology:

PMN = Pliocene
Marine and
Non-Marine
Sediments

FR = Franciscan
Formation

SV = Sonoma Volcanics

QS = Quaternary
Sediments

TLS = Tailings

Vegetation:

U = Urban

MF = Mixed Forest

CF = Coniferous Forest

GR = Grassland

BR = Brushland

WL = Wetland

Groundwater:

1 = Extensive Basin

2 = Moderate Basin

3 = Poor Basin

4 = Inconsistent Yields

5 = Water from Springs
or Faults Only

Hydrology:

FH = Flood Hazard

PS = Perennial Stream

AR = Aquifer Recharge

W = Wetland

TABLE II. A-2

PLANNING DESIGNATIONS

	Land Use Map		Critical Open Space Map			Re-sources & Undeveloped Map	Other Plans
	Site	Surr.	S.A.	S.C.	U.F.		
<u>BORROW PITS</u>							
1) ARFSTEN	City	City				DEV	Petaluma General Plan
2) BOHAN & CANELIS	U	RES		X	X	MR	
3) CHENOWETH	U	U				U	Harrison Grade Road Specific Plan
4) GHILOTTI	U	U	X	X		MR	
5) GRAHAM	OL&R	OL&R/ U/AR				MR/ DEV	West Sebastopol Specific Plan
6) GREEN VALLEY	U	U/GA		X		MR/U	Forestville Specific Plan
7) HAGEMANN	U	U		X		U	Local Coastal Plan
8) PASSALAUQA	U	U	X	X		MR	Local Coastal Plan
9) SPALETTA	U	U/GA	X			U	Sonoma Mtn. Specific Plan
10) STAGE GULCH	GA	GA	X	X		MR	
11) TRANSCENTURY	SH	SH	X	X		DEV	Local Coastal Plan
<u>QUARRIES</u>							
1) BLOOMFIELD	GA	GA				MR	
2) BLUE ROCK	U	U		X		U	Forestville Specific Plan
3) BROOKS	U	OL&R	X			DEV/U	
4) CANYON	U	U		X	X	U	Forestville Specific Plan
5) CINNABAR	U	U				U	
6) INMAN	U	U				U	
7) MARK WEST	U	U		X		U	Franz Valley Specific Plan
8) NUN'S CANYON	U	O&V/U	X	X		U	
9) QUARRY PRODUCTS	City	City	X	X		DEV	Petaluma General Plan
10) SONOMA ROCK	GA	GA/U		X		MR	South Sonoma Valley Areas 3 and 4 Specific Plan
11) STONY POINT	U	U/RR	X			MR	
12) TRINITY	GA	GA/U	X	X		DEV	
13) ZAMARONI	U	U/AR	X	X		MR/U	Bennett Valley Specific Plan

Surr. = Surrounding
 S.A. = Scenic Area
 S.C. = Scenic Corridor
 U.F. = Unique Feature

KEY TO CHART

General Plan Land Use Map:

GA = General Agriculture

U = Undeveloped

OL&R = Open Land and Residential

SH = Second Home Development

AR = Agriculture and Residential

O&V = Orchards and Vineyards

RR = Rural Residential

RES = River Resort

Resources and Undeveloped Map:

DEV = Development

MR = Managed Resource

UND = Undeveloped

Location: Harrison Grade Road and
Green Valley Road,
Sebastopol

The Chenoweth Quarry is located in a steep-sloped, coniferous forest northwest of Sebastopol. Access to the site from the north and east is Green Valley Road and from the south Harrison Grade and Graton Roads. Surrounding uses are primarily open land, timber, and some grazing. The excavation covers about 1.5 acres and consists of several tiers or benches set back against the +30% slope. An intermittent creekbed borders the quarry on the south. Although no residences are immediately affected by the site, several exist along the various haul routes. The area is designated as "Undeveloped" on the General Plan Land Use Map and Resources and Undeveloped Map. It is also within a fire hazard area (CDF). The Harrison Grade Road Specific Plan designates the entire parcel as extensive agricultural.

(4) Ghilotti Bros., Inc.

Geology: Pliocene marine and non-marine sediments
Product: Fill and subbase
Location: Lakeville Highway and Highway 116 east of Petaluma

The pit supplies various construction fills for the Ghilotti Brothers construction firm. Access to the site is a small private road off of Lakeville Highway north of its intersection with Stage Gulch Road. Area vegetation is predominantly grassland used for grazing purposes. Slopes are fairly steep at 15-30%. The excavation is bowl-shaped and screened from the view of both Highway 116 and Lakeville Highway.

The site is designated as undeveloped on the General Plan Land Use Map, managed resource (agriculture) on the Resources and Undeveloped Map, and both

scenic area and scenic corridor on the Critical Open Space Map.

(5) Graham

Geology: Pliocene marine and non-marine sediments and Franciscan formation
Product: Fill and subbase
Location: Graton Road near Harrison Grade Road, Occidental

The Graham quarry covers about three acres of hilly terrain immediately abutting Facendini Lane. To the east vegetation is coniferous forest, with some orchard and grazing activities nearby. A few residences are scattered around the remainder of this small valley east of Occidental. Access to the west and east is via Graton Road. Some prime soil occurs on the adjacent valley floor to the west.

The General Plan designates the site as open land/residential on the Land Use Map, and managed resource (agriculture) on the Resources and Undeveloped Map. The site lies within the voundary of the West Sebastopol Specific Plan and is therein designated as agriculture.

(6) Green Valley (Giovannini)

Geology: Franciscan formation
Product: Fill, subbase
Location: Green Valley Road, Sebastopol

The excavation covers about one acre and is on the same site as the G & S Lumber Company operation on Green Valley Road west of its intersection with Garrison Grade Road. The cut slope is very steep in an area of +30% slopes. Access is via Green Valley Road to either Highway 116 or Harrison Grade Road and Graton Road. Vegeta-

tion is "mixed forest", and surrounding uses include a logging operation, some farming, and open land. To the south is a youth camp used during summer months.

The General Plan designates the site as undeveloped on the Land Use Map, managed resource (timber) and undeveloped on the Resources and Undeveloped Map, and Green Valley Road is a scenic corridor on the Critical Open Space Map. The parcel is indicated as A-1 (primary agriculture) in the Forestville Specific Plan. The California Division of Forestry has determined that the site is part of a fire hazard area.

(7) Hagemann Ranch

Geology: Pliocene marine and non-marine sediments
 Product: Fill and subbase
 Location: Highway 1 near Bodega Bay (Cheney Gulch)

The quarry is located 2.5 miles east of Bodega Bay on the north side of Highway 1. The three-acre excavation consists of a steep cut slope to the northwest side of a small canyon. Vegetation is grasslands used for grazing purposes. Access is directly onto Highway 1.

The General Plan designates the site as undeveloped on the Land Use Map and undeveloped on the Resources and Undeveloped Map. Highway 1 is designated as a scenic corridor on the Critical Open Space Map and a bikeway on the Highway Map. The site is located within the Coastal Zone.

(8) Passalacqua

Geology: Franciscan formation
 Product: Fill materials, subbase
 Location: Coleman Valley Road, Bodega Bay

The quarry is located along the ridge line

northeast of Bodega Bay. The excavation, about one acre in size, is from a small outcropping immediately surrounded by oak and bay laurel in a grassland area used for grazing sheep. Access is via Coleman Valley Road, which is designated as a scenic corridor on the General Plan Critical Open Space Map. The quarry also lies within a scenic area on the same map. Otherwise, the General Plan designates the area as undeveloped on the Land Use Map and managed resource (agriculture) on the Resources and Undeveloped Map.

(9) Spaletta

Geology: Sonoma Volcanics
 Product: Fill and subbase
 Location: West slope of Sonoma Mountain off of Manor Lane

The operation is an intermittent one, supplying occasional construction projects in the Petaluma and Sebastopol areas. The rolling foothills around the site have slopes ranging between 15% and 30%. Vegetation is grassland used for grazing purposes. Access is via Adobe Road and Manor Lane from the east Petaluma area.

The General Plan designates the area as undeveloped on the Land Use Map with some general agriculture in the vicinity. The site is undeveloped on the Resources and Undeveloped Map and a scenic area on the Critical Open Space Map. The site location lies within the Sonoma Mountain Specific Plan boundary and is designated as undeveloped and zoned agricultural.

(10) Stage Gulch

Geology: Sonoma Volcanics
 Product: Fill and subbase
 Location: Highway 116 (Stage Gulch Road) between Sonoma and Lakeville Highway

The excavation consists of several smaller cuts in a five-acre area. It is adjacent to and uses the same access road as the County refuse disposal site. The disturbed area is just below the east side of the ridge line separating the Sonoma and Petaluma Valleys. Vegetation in the vicinity is grassland and used for grazing purposes. A small creekbed is located through the center of the site. Access to the site is Highway 116 to the east and west.

The General Plan designates the area as general agriculture on the Land Use Map, managed resource (agriculture) on the Resources and Undeveloped Map, and a scenic area on the Critical Open Space Map. In addition, Highway 116 is designated as a scenic corridor.

(11) Transcentury

Geology: Franciscan formation
 Product: Fill and subbase
 Location: Highway 1 east of Bodega Bay
 (Cheney Gulch)

This series of five excavations along Highway 1 at Cheney Gulch is adjacent to and supplied materials to the Bodega Harbour Development. Vegetation is brushland on slopes ranging from 15% to 30%. Neighboring uses are open space, grazing and residential above the ridge immediately to the south. The bottom floor of the largest excavation is presently a reservoir pumping station.

Highway 1 is designated as a scenic corridor in the General Plan Critical Open Space Map and a bikeway on the Highways Map. The quarry area is also designated for second home development on the Land Use Map and Resources and Undeveloped Map, and a scenic area on the Critical Open Space Map. The sites are located within the Coastal Zone.

QUARRIES

(1) Bloomfield Quarry

Geology: Pliocene marine and non-marine sediments
 Product: Presently being tested for asphalt concrete and base; fill and subbase in past
 Location: Bloomfield Road north of Bloomfield

The present excavation occupies approximately four acres facing northwest from the southeast side of Bloomfield Road in an area where slopes range from 15% to 30%. Access is via Bloomfield and Petaluma-Valley Ford Roads to points south, and Bloomfield Road and Highway 116 to points north. Predominant vegetation is grassland used for grazing purposes. One residence exists directly across Bloomfield Road and slightly to the southwest of the present excavation. The area is designated by the General Plan as general agriculture on the Land Use Map and managed resource (agriculture) on the Resources and Undeveloped Map.

(2) Bluerock Quarry

Geology: Franciscan formation
 Product: Subbase, drain rock, fill
 Location: Highway 116 west of Forestville

The quarry parcel is adjacent to and southwest of the Canyon Rock Quarry (see No. 4) across Highway 116. Slopes are greater than 30% and vegetation is mixed forest. Onsite processing includes crushing, dozing, ripping and occasional blasting. Access is via Highway 116 with alternative routes to the west via either Mirabel Road to River Road or Highway 116 through Forestville to Guerneville Road. Surrounding uses are open land and mining.

The General Plan designates the site and surrounding

area as undeveloped on the Land Use and Resources and Undeveloped Maps. Highway 116 is designated as a scenic corridor on the Critical Open Space Map and a bikeway on the Highways Map. The Forestville Specific Plan designates the site as primary agriculture. The site is also in a fire hazard zone according to California Division of Forestry (CDF).

(3) Brooks Quarry

Geology: Sonoma Volcanics
 Product: Riprap, fill
 Location: Brooks Road northeast of Windsor

The shallow ten-acre quarry is located in terrain with slopes ranging between 15% and 30%, though the actual excavated area itself is more gently sloped. The operation is intermittent and often occurs during winter months, when emergency flood control projects are underway. Access is via Brooks Road, where development has been taking place in recent years. Blasting is occasionally necessary, but no processing is undertaken onsite. Surrounding vegetation is grassland and oak and used for grazing purposes. The quarry is in an area designated as a fire hazard area by the CDF.

General Plan designations are undeveloped with open land/residential to the west on the Land Use Map and Resources and Undeveloped Map. The site is also within a scenic area on the Critical Open Space Map, though the operation is not visible from Brooks Road to the south.

(4) Canyon Rock Quarry

Geology: Franciscan formation and Quaternary sediments along Green Valley Creek
 Product: Base, subbase, fill, drain
 Location: Highway 116 west of Forestville

The quarry (15 acres) borders the west bank of Green Valley Creek adjacent to and across the street from the Blue Rock Quarry (see No. 2). Concrete aggregates are imported from offsite and mixed in a batching plant along the creek. Other onsite processing includes a crushing and screening operation. Access is via Highway 116. Alternative routes to the west are either Mirabel and River Roads or Highway 116 through Forestville to Guerneville Road. Slopes in the area are in excess of 30% and covered by mixed forest, giving the area a fire hazard designation (CDF). The eastern portion of the site includes both prime soils and aquifer recharge associated with Green Valley Creek.

Highway 116 at the quarry site is designated by CALTRANS and the County General Plan Highways Map as a bikeway. The Critical Open Space Map indicates Highway 116 as a scenic corridor. The quarry site is further designated as undeveloped on the Land Use Map. In addition, the riparian corridor of Green Valley Creek is a unique feature on the Critical Open Space Map. The Forestville Specific Plan has designated the site for agriculture.

(5) Cinnabar Quarry (Guerneville Quarry)

Geology: Site geology is Franciscan Greenstone, but the mining operation is processing tailings from the old mercury mining operation.
 Product: Asphalt concrete, base, subbase, fill, drain, pipe bedding
 Location: Sweetwater Springs Road north of Guerneville

The quarry is located on the former site of the Mt. Jackson mercury mine. The operation is presently converting the cinnabar tailings to aggregate for construction purposes. Slopes in the area exceed 30%, but the crushing, screening, and washing operations are situated on the floor of a small canyon bordering Fife Creek. Wash water is pumped from aquifer gravels underlying the site. Vegetation is mixed forest, and the area is part of a fire hazard zone (CDF). Semi-permeable

(Class 4) soils underlie the cinnabar stockpile and mining operation. Surrounding uses are primarily open land since the mercury mining operation ceased several years ago. In addition to a contractor's yard to the south, a few residences are situated near the operation and along the Sweetwater Springs Road access route. The General Plan designates the area as undeveloped on both the Land Use Map and the Resources and Undeveloped Map.

(6) Inman Shale Pit

Geology: Franciscan formation
 Product: Fill, subbase
 Location: Wallace Creek Road west of
 Healdsburg

Located in an area with 15% to 30% slopes in the mountains west of Healdsburg, the one-acre quarry produces materials for local consumption only. Processing equipment includes a loader and portable crusher. Blasting is occasionally required to loosen earth materials from the fairly steep cut slope. Access to the site is via Westside Road to Mill Creek and Wallace Creek Roads. Across Wallace Creek Road south of the site is Wallace Creek, a perennial stream. The site is in a mixed forest community and surrounding uses are open land, occasional residences, and some grazing. CDF has designated the site as being within a fire hazard area. The General Plan designates the area as undeveloped on the Land Use Map and Resources and Undeveloped Map.

(7) Mark West Shale Pit

Geology: Franciscan formation
 Product: Base, subbase, fill, drain,
 etc.
 Location: Porter Creek Road northeast
 of Santa Rosa

The five-acre quarry is located near the Napa County border west of Porter Creek Road's intersection with Calistoga Road. The bulk of materials from the quarry is delivered to the Napa County market. Processing performed onsite includes occasional blasting, ripping, loading, crushing and screening. Area terrain is mountainous (+30% slopes) and vegetation is mixed forest, resulting in a fire hazard designation (CDF). Adjacent uses are predominantly open land with the Petrified Forest tourist area to the east. Residential uses occur to the south and west along Calistoga and Mark West Springs Roads, which are the primary access routes to and from Sonoma County markets.

The General Plan designations for the area are undeveloped on the Land Use Map and Resources and Undeveloped Map. The Critical Open Space Map designates Calistoga and Porter Creek Roads as scenic corridors. The Franz Valley Specific Plan designates the site for resource conservation.

(8) Nun's Canyon Quarry

Geology: Sonoma Volcanics
 Product: Decorative rock
 Location: Trinity Road north of Sonoma

The three-acre excavation of volcanic felsite consists of several cut slopes and a pad for crushing and screening equipment. The processing operation removes fine-grained materials which are deposited on site. Access is via Highway 12 and Trinity Road. Surrounding vegetation is brushland on slopes in excess of 30%. The operation borders two small canyons which drain a portion of the upper Sonoma Creek watershed during winter months into an offsite intermittent stream to the south. Adjacent uses are a turkey farm, another quarry, and occasional residences to the south along Trinity Road.

General Plan designations for the area are undeveloped (some orchard and vineyard to the northeast) on the Land Use Map and Resources and Undeveloped Map. The Critical Open Space Map shows the site within a scenic area (though the quarry is well-screened from view) and designates Highway 12 and Trinity Road as scenic corridors. Highway 12 is also designated as a bikeway on the Highways Map.

(9) Quarry Products, Inc. (Petaluma Quarry)

Geology: Sonoma Volcanics
 Product: Asphalt concrete, base, sub-base, drain, fill
 Location: South of Petaluma along Highway 101

Truck access to the large 50-acre quarry is via Highway 101 and Petaluma Boulevard South. Supplemental materials are also imported to the site by barge via the Petaluma River. The excavation consists of a steep, north-facing, cut slope abutting an adjacent parcel. Present extraction operations are lowering the quarry floor. Processing operations include crushing, screening, washing, and asphalt batching. Wash water is pumped from alluvial materials underlying the Petaluma River and recycled. Surrounding vegetation is grassland to the south. Neighboring uses are grazing, a golf course, and urban residential development is anticipated on the present golf course site to the south.

The quarry is within the urban expansion area of the City of Petaluma. The County General Plan Critical Open Space Map designates the site as a scenic area and Highway 101 as a scenic corridor. The Petaluma General Plan indicates the site as "general industrial", while the Environmental Design Plan calls for an "agriculture/open space" designation.

(10) Sonoma Rock, Inc.

Geology: Sonoma Volcanics
 Product: Base, subbase, fill, drain, etc.
 Location: Highway 121 southwest of Sonoma

The five-acre quarry borders the wetlands of the Sonoma Creek watershed. The tapered cut face is gently sloped (0-5%) and screened from the view of Highway 121 motorists by a ridge. Extraction requires occasional blasting, and the processing operation involves crushing and screening. Truck access is via Highway 121. A rail line runs immediately adjacent to the site, but no spur exists and the line is not presently used for hauling. Vegetation is grassland used for grazing to the west and diked wetland used for grazing and crop production to the east. The wetland area consists of prime soils which are subject to periodic flooding.

The General Plan designates the area as general agriculture on the Land Use Map and managed resource (agriculture) on the Resources and Undeveloped Map. The Critical Open Space Map identifies Highway 121 as a scenic corridor. The South Sonoma Valley Areas III and IV Specific Plan indicates agricultural use for the site.

(11) Stony Point Quarry

Geology: Pliocene marine and non-marine sediments
 Product: Subbase, fill, drain rock
 Location: Stony Point Road west of Cotati

The excavation of approximately ten acres consists of several working faces cut against rolling grassland terrain (slopes: 15-30%). Material processing consists of crushing and

screening. Access is via Gravenstein Highway and Stony Point Road to the northeast and west and Stony Point Road and Highway 101 to the south. Surrounding uses are grazing. The site is undeveloped on the General Plan Land Use Map though a small pocket of rural residential development is project to the northeast of and across Stony Point Road from the quarry. The area is managed resource (agriculture) on the Resources and Undeveloped Map and a scenic area on the Critical Open Space Map.

(12) Trinity Quarry

Geology: Sonoma Volcanics
 Product: Decorative rock, flagstone
 Location: Trinity Road north of
 Sonoma

The presently inactive quarry is located downslope of and adjacent to the Nun's Canyon Quarry (see No. 8) and produces decorative rock products from the same felsite deposit. Access is via Highway 12 and Trinity Road. Processing includes crushing and screening, but reserves are limited. Vegetation is grass and brushland and neighboring uses are a turkey farm, the mining operation, and other residences along Trinity Road. Designations include general agriculture on the General Plan Land Use Map, so limited development is shown on the Resources and Undeveloped Map. The site lies within a scenic area on the Critical Open Space Map. Trinity Road is also a scenic corridor and Highway 12 is a scenic corridor and bikeway.

(13) Zamaroni Quarry

Geology: Sonoma Volcanics
 Product: Subbase, fill
 Location: Petaluma Hill Road south of
 Santa Rosa

The large excavation consists of a benched, west-facing cut against the foothills of Taylor Mountain on the east side of Petaluma Hill Road. The processing operation is limited to occasional crushing with portable equipment. Access is from the north and south via Petaluma Hill Road and west toward Santa Rosa Avenue and Highway 101. Vegetation is mixed forest and used for grazing and open space.

The County General Plan designates the area as undeveloped on the Land Use Map and the Resources and Undeveloped Map. The site is further designated as a scenic area, and Petaluma Hill Road is both a scenic corridor and bikeway on the Critical Open Space and Highway Maps, respectively. The Bennett Valley Specific Plan designates the site as agricultural/open space.

II. B.

DESCRIPTION OF EXISTING ENVIRONMENT:

HYDROLOGIC HISTORY OF THE RUSSIAN RIVER WATERSHED

To understand the present Russian River environment and its behavior in relation to the extraction of gravels, a look at the hydrological history of the river and its watershed is necessary. The following historical sketch covers two main areas:

1. The physical characteristics of the river channel and its tributaries (e.g., channel gradient and meander, bedload and suspended load movement, flow, water quality, flooding and erosion);
2. The human activities which have influenced the character of the river channel and its tributaries (e.g., mining, logging, recreation, agriculture and other land uses as well as dams, levees, bridges, and stream crossings).

Most of the data available on the Russian River drainage system have been collected in the last forty years. Little is available prior to a survey conducted by the U. S. Army Corps of Engineers in 1940. The 1940 survey included river cross-sections and aerial photographs from Jenner to Ukiah. Descriptions of the river and its changes have been provided by a number of people, based on their experiences as residents of the area.

GEOLOGIC HISTORY

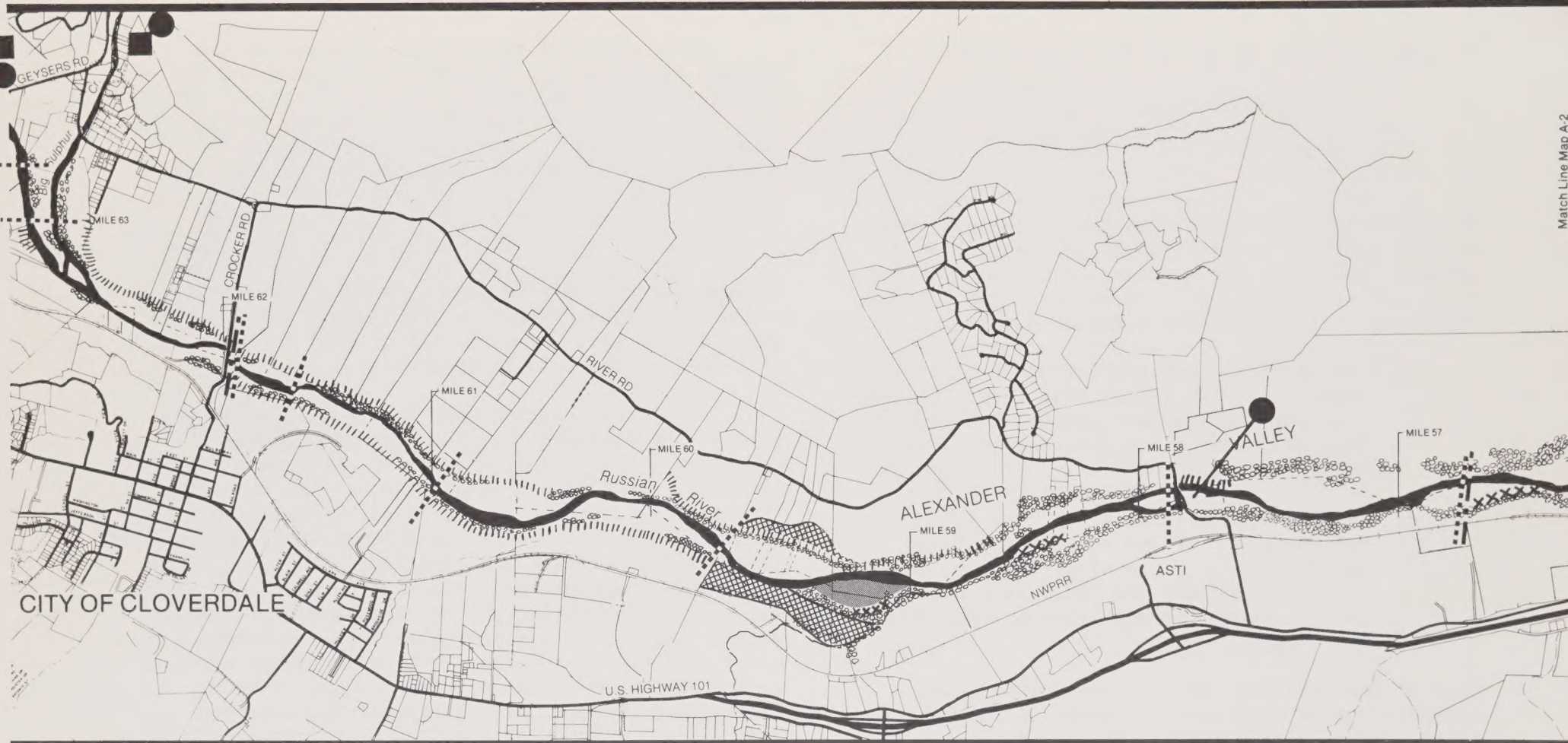
*"Evolution of the Russian River Drainage" from
"EROSION ALONG DRY CREEK"
(Cleveland and Kelley)*

"Development of the general features of the present course of the Russian River system and its tributaries occurred during Pleistocene time. At that time, the main river developed a meandering course to the sea across a surface of low relief underlain by soft marine deposits that had only recently emerged by uplift. Higgins (1952) points out that as this surface slowly rose, the river maintained its meandering course as it cut into the rising land surface. Eventually the river cut down through the soft marine sands into the harder rocks of the Franciscan Formation and incised a vee-shaped gorge to the sea, retaining the general sinuous alignment of the original meanders.

"The stream courses were well developed by the time of the Wisconsin stage of the Pleistocene (Higgins, 1952). Great amounts of water were stored in thick accumulations of continental ice resulting in a general lowering of sea level estimated at about four hundred feet. The Russian River graded its channel to this lower base level.

"When temperatures increased following the Wisconsin stage the ice of the continental glaciers melted, leading to a rise in sea level, and the river and the lower parts of its tributaries began to aggrade their channels. The bottoms of the channels became clogged and the streams began to move laterally in broad meanders distributing gravel across the width of the valleys and leaving behind abandoned stream channels. A prolonged period of stable sea level and the absence of tectonic activity allowed the development of relatively level floodplains in the valley of the Russian River and lower Dry Creek. Periodically floods overtopped the channel banks, spreading rich alluvial soils over the valley floor. This stable period lasted long enough so that some tributaries of Dry Creek, specifically Mill and Pena Creeks, developed meanders in their lower courses across the Dry Creek valley floodplain.

"The most recent regional change in the evolution of this river system has been a net lowering of



 PERENNIAL STREAM
 INTERMITTENT STREAM

 RIPARIAN VEGETATION

 FORMER RIPARIAN VEGETATION

 MINING OPERATION

DATA COLLECTION STATIONS
 U.S.G.S.  N.C.R.W.Q.C.B.  D.W.R.

CROSS SECTIONS
 U.S. CORPS OF ENGINEER  S.C.W.A.

BANK STABILIZATION
 LEVEES  OTHER STABILIZATION MEASURES

Russian River, Alexander Valley Cloverdale Section Map A-1

HYDROLOGY

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
 0 900 1800 Meters



PERENNIAL STREAM
INTERMITTENT STREAM



RIPARIAN VEGETATION



FORMER RIPARIAN VEGETATION



MINING OPERATION

DATA COLLECTION STATIONS

■ U.S.G.S. ● NCRWQCB * D.W.R.

CROSS SECTIONS

----- U.S. CORPS OF ENGINEER --- S.C.W.A.

BANK STABILIZATION

||||| LEVEES x x x x OTHER STABILIZATION MEASURES

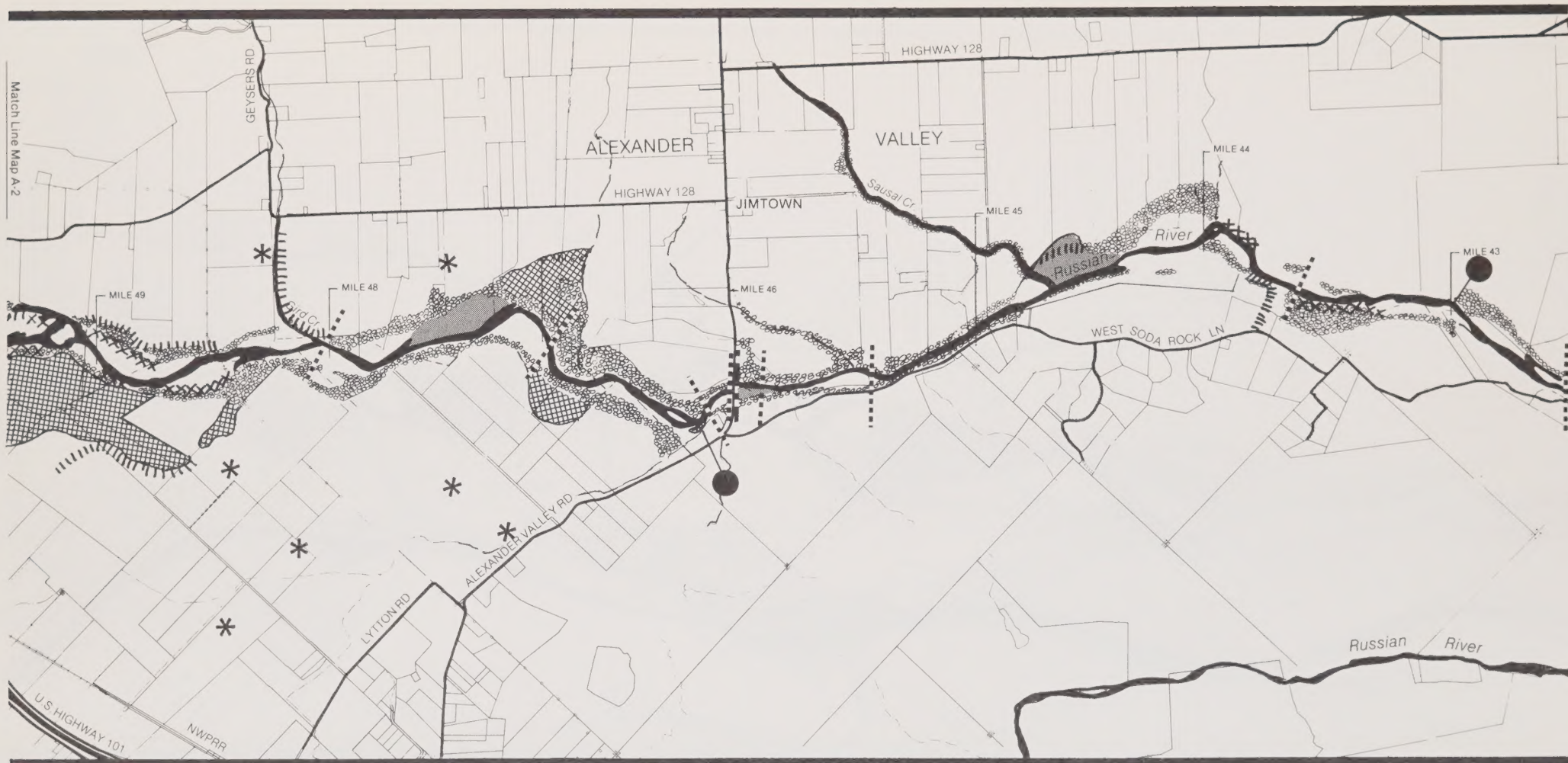
Russian River, Alexander Valley Geyserville Section Map A-2

HYDROLOGY

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
0 900 1800 Meters



 PERENNIAL STREAM
 INTERMITTENT STREAM

 RIPARIAN VEGETATION

 FORMER RIPARIAN VEGETATION

 MINING OPERATION

DATA COLLECTION STATIONS

 U.S.G.S.  N.C.R.W.Q.C.B. * D.W.R.

CROSS SECTIONS

..... U.S. CORPS OF ENGINEER --- S.C.W.A.

BANK STABILIZATION

||||| LEVEES x x x x OTHER STABILIZATION MEASURES

Russian River, Alexander Valley Jimtown Section Map A-3

HYDROLOGY

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
 0 900 1800 Meters



 PERENNIAL STREAM
 INTERMITTENT STREAM

 RIPARIAN VEGETATION

 FORMER RIPARIAN VEGETATION

 MINING OPERATION

DATA COLLECTION STATIONS
 U.S.G.S.  N.C.R.W.Q.C.B. * D.W.R.

CROSS SECTIONS
 U.S. CORPS OF ENGINEER  S.C.W.A.

BANK STABILIZATION
 LEVEES  OTHER STABILIZATION MEASURES

 STREAMBANK EROSION

Dry Creek, Dry Creek Valley Yoakum Bridge Section Map B-1 HYDROLOGY

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
 0 900 1800 Meters

Match Line Map B-2



PERENNIAL STREAM
INTERMITTENT STREAM



RIPARIAN VEGETATION

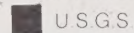


FORMER RIPARIAN VEGETATION

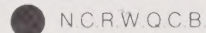


MINING OPERATION

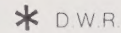
DATA COLLECTION STATIONS



U.S.G.S.

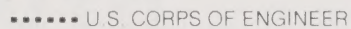


N.C.R.W.Q.C.B.



D.W.R.

CROSS SECTIONS



U.S. CORPS OF ENGINEER

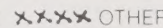


S.C.W.A.

BANK STABILIZATION



LEVEES



OTHER STABILIZATION MEASURES



STREAMBANK EROSION

Dry Creek, Dry Creek Valley Healdsburg Section

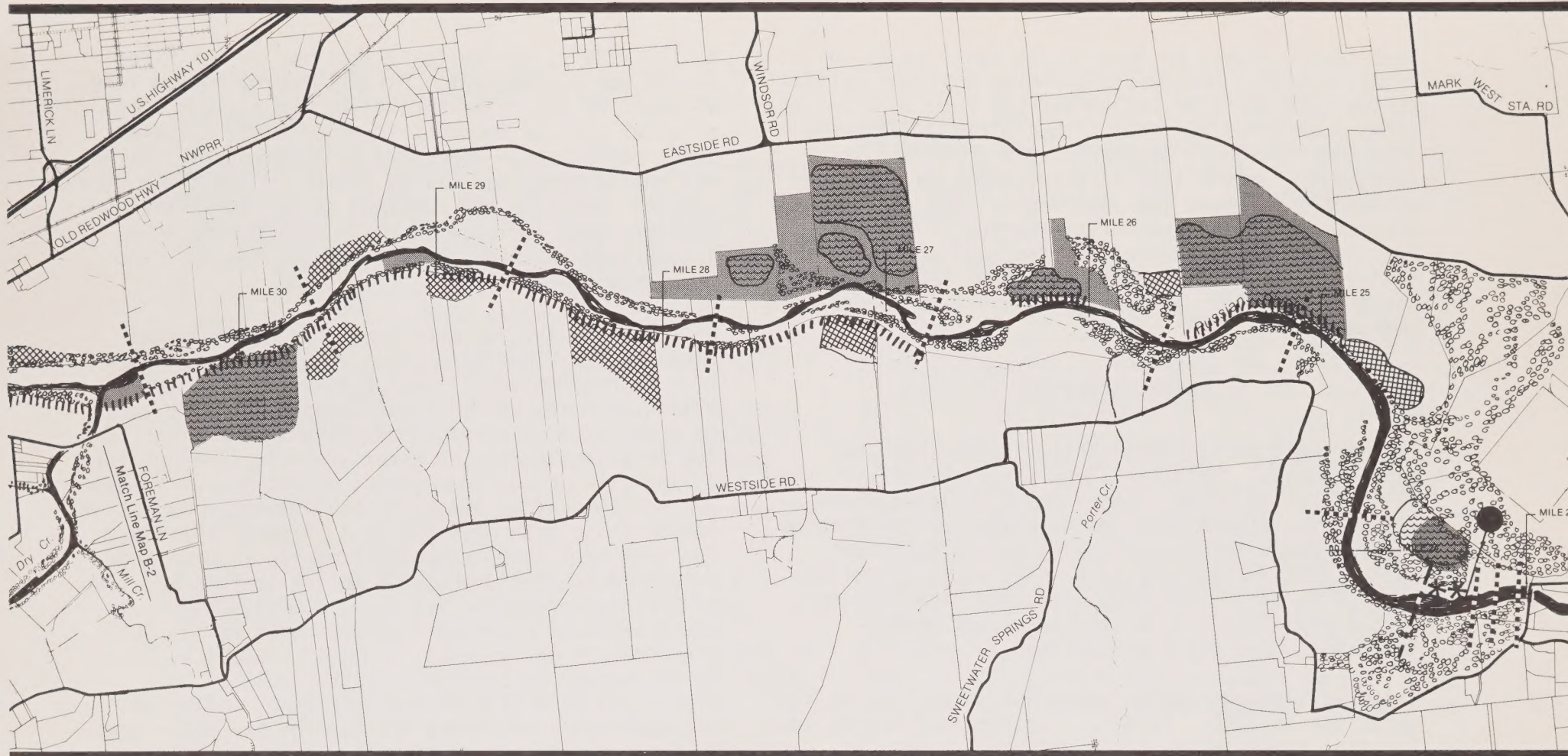
Map B-2

HYDROLOGY

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
0 900 1800 Meters



 PERENNIAL STREAM
 INTERMITTENT STREAM

 RIPARIAN VEGETATION

 FORMER RIPARIAN VEGETATION

 MINING OPERATION

DATA COLLECTION STATIONS
 U.S.G.S.  N.C.R.W.Q.C.B. * D.W.R.

CROSS SECTIONS
 U.S. CORPS OF ENGINEER --- S.C.W.A.

BANK STABILIZATION
 LEVEES  OTHER STABILIZATION MEASURES

 EXPOSED GROUND WATER

Russian River, Middle Reach Map C

HYDROLOGY

Aggregate Resources Management Study
 Community and Environmental Services
 Planning Division, Sonoma County Calif.

 Scale 0 3000 6000 Feet
 North 0 900 1800 Meters

base level, either by drop in sea level or by regional uplift. Gealey (1951) noted a slight uplift during Holocene time had caused the Russian River to erode once more, and that it had already cut downward some 20 feet. Similarly, Dry Creek and its tributaries on the flat valley surface have become entrenched to about the same depth. The ancient downcutting of the meandering courses of Mill and Pena Creeks are preserved in steep-walled, flat-floored channels. Although Dry Creek Channel winds somewhat normally, it does not exhibit well-developed meanders."

HUMAN SETTLEMENT

The earliest basin inhabitants were the Pomo and Wappo Indians. Settling along the river itself, the various tribes often located their villages where tributaries flowed into the main stem of the Russian River. Wappo tribes could be found in Alexander Valley from Geyserville (R.M. #52) south to Healdsburg (R.M. #42). The Pomos occupied territory upstream from Geyserville, the area surrounding Healdsburg, and Dry Creek Valley.

White settlement surged just prior to and during the gold rush in 1850. Farming, logging, and mining activities developed as towns sprang up along the river basin in Sonoma County. Cloverdale, Healdsburg and Geyserville, among others, were well established communities by the early 1900's. Valley oaks by the thousands were cut and cleared so the fertile soils overlying the valley sands and gravels could be cultivated in wheat and hops and later orchard and vineyard. The mountainous areas of the watershed, especially the coast ranges, were logged for redwood and fir, and in many cases converted to grazing. Mercury mining began in the Big Sulphur and Pine Flat areas and north of Guerneville on Mt. Jackson. Rock, sand and gravel mining operations were common in the Russian River channel near Healdsburg and Alexander Valley and other river communities.

By the 1930's, agricultural activity in the river basins was predominant. Farmers sought bottom land adjacent to the river because of the availability of water and the abundant layer of rich, alluvial soils periodically deposited by floodwaters. As additional acreage was tilled closer to the river, the channel gradually was confined to an increasingly narrower path. Planted acreage thus became more susceptible to frequent flooding and loss of land through erosion.

Flooding and erosion were major concerns of residents of the Cloverdale area. Following construction of Preston and Crocker Road Bridges in the 1930's, farmers banded together in a local attempt to provide flood control and streambank protection for crops bordering the river channel. The "Cloverdale-Russian River Improvement District" was formed. Funds collected by the District financed a system of levees along both east and west banks of the river. The west bank levee extended from the Crocker Road Bridge (R.M. #62) downstream to the present location of the Cloverdale Airport (R.M. #59.5). The east bank structure extended from the mouth of Big Sulphur Creek south to Asti (R.M. #62.5-58.5). The levees tended to confine the river channel to a narrow and straightened configuration, making additional lands available for farming and other uses. At least two lumber companies constructed milling operations (R.M. #60 and #61.5) on newly protected stream channel lands.

The levees have remained fairly stable over the years, though occasional repair has been necessary. The 1956 and 1965 floods eroded the levees in various places, necessitating repair efforts by the Army Corps of Engineers and the City of Cloverdale, respectively. Levee stability in this area may be partially explained by the fact that the river channel gradient is relatively steeper around Cloverdale than it is downstream of Chianti. In addition, the bedrock exposure around Asti naturally constricts and stabilizes the channel, causing the

valley to somewhat resemble the reach through Hopland in Mendocino County or Fitch Mountain near Healdsburg.

Downstream of the levees, where the alluvial deposits extend over a broader, gently sloping valley, the river channel retained its meandering character. The 1947 aerial photographs show that the Alexander Valley channel was complex, often braided and relatively undefined (see map). Characterized by secondary and tertiary flood channels, backflows, riffles, and pools lined with riparian growth, the channel regularly meandered as it eroded and deposited stream gravels. At the same time, the varied and diverse stream habitat supported, according to local residents, a relatively large and diverse fish population. Agricultural uses in this portion of the valley were widespread, but had not yet encroached upon the riparian areas to the extent that they had near Cloverdale.

Dry Creek Valley, by 1940, had been extensively plowed for orchard crop or vineyard production. Though farmers had planted fairly close to the creekbed in many locations along Dry Creek, a belt of mature riparian growth existed along most of both banks downstream of Bord Bridge (D.C.R.M. #14). The 1940 and 1945 aerial photographs, however, show some locations (see map) where cultivation of former riparian acreage was in progress (D.C.R.M. #1.2, 2.4, 3.0, 3.9, 5.7, 6.3, 10.0). The creek channel, unlike the Russian River channel in Alexander Valley, had a relatively straight and well-defined alignment below Lambert Bridge (see map) (D.C.R.M. #7). Upstream from the bridge, the channel was less confined and exhibited a more pronounced meandering pattern.

Other activities within the Dry Creek Watershed also affected the channel characteristics. Sand and gravel mining had been occurring on a small scale instream near Westside Bridge (constructed in 1934) (R.M. #2.1) for many years. In the upper elevations

of the watershed, erosion caused by grazing and logging activities continued to contribute sediment and bedload to the lower Dry Creek channel. Conversion of forests and woodland areas to grassland and commercial logging operations began in earnest in the late 1800's and early 1900's, substantially increasing runoff.

The Russian River between Healdsburg and Wohler Bridge was characterized by its meanderings through the broad valley west of Windsor before it turned west through the coastal range and summer resort areas of Guerneville and Monte Rio. Following construction of the railroad bridge, the Healdsburg and Wohler Bridges were built in 1921. Agricultural activities were extensive and, in a few instances, restricted the width of the river channel (see map). In the vicinity of Healdsburg, mining operations regularly removed inchannel gravels, providing some local flood control benefits. Orchard crops were predominant, with hops and grapes present. Aerial photographs show several portions of the river channel that were close to forming "ox-bow" meanders similar to present day Pena Creek (D.C.R.M. #12) in Dry Creek Valley. Abundant riparian growth and the presence of alternate flood channels in this reach were similar to those in the Alexander Valley channel (see map).

FLOOD OF FEBRUARY, 1940

The winter of 1939-1940 brought heavy rainfall to the Russian River watershed. Runoff was increased by logging and cultivation of upper watershed lands. Excessive rains, shallow channel depths, low banks, and heavy riparian growth, coupled with natural topographic barriers to flood flows at Fitch Mountain and Wohler Bridge, caused the river to overtop its banks. The slow-moving water spread over the valley floors and deposited silts and fine particles over the existing alluvium. As the flood waters gradually receded and picked up speed, some, but not all, of these fines were washed away. Bedload gravels

normally transported during intense peak flows bounced along the river bed and reformed gravel bars in new configurations. The flood waters brought inconvenience and loss to residents of the valleys who found several inches of mud and silt in their homes and some damaged crops. However, the increase in fertility and productivity of the land was a long-term benefit.

POST WORLD WAR II

Following World War II, the mining of instream gravels increased in the Healdsburg area (see mining history section), significantly changing the river channel in that vicinity. As materials were removed from instream pits, winter flows would refill the holes with bedload from upstream sources. Beginning in 1940, the Russian River at its confluence with Dry Creek was mined to depths of up to 55 feet below the water level, stringing large pits together over a distance of approximately three miles.

At the same time, a levee was constructed along the west bank of the Russian River from the Healdsburg Avenue Bridge to a point 1.5 miles downstream of the Dry Creek mouth (R.M. #29). The levee was constructed for several purposes: (1) Basalt Rock Company needed access to a number of gravel bars in the river channel, (2) Westside Valley residents were provided with some protection from flood waters not only by the levee, but also by the increased channel capacity, and (3) additional planting acreage became available in some locations behind the levee.

When other mining operations began farther downstream, the entire nine mile reach of channel was lowered significantly, with total removal reaching an estimated 23,000,000 tons. The newly constrained channel was deeper and straighter than before. High winter flows moved more rapidly through the reach, finally backing up when they reached the Wohler to Guerneville stretch. No longer did flood waters spread over the land, replenishing and depositing soil and organic materials.

The winter flows were also faster-moving with an increased potential to erode. Though the peak flows were less likely to overtop the winter channel, the increased volume and velocity caused erosion within the channel itself. Aerial photographs taken during the late 1940's and 1950's show erosion occurring along the west bank levee (R.M. #30). Net channel degradation has also occurred ranging between 1' at the Basalt crossing and 19' near Kaiser's north pit (R.M. #26.8).

The excavation of large pits in the Russian River created a "knickpoint" which gradually migrated upstream as gravels moved downstream to fill the pits, contributing to channel bottom degradation over a portion of both the Dry Creek and Russian River channels.

The increased velocity in the Russian River coupled with the excavations at the mouth of Dry Creek were most likely contributing factors in the extensive vertical and lateral erosion which took place along both banks of Dry Creek below Westside Bridge during the 1950's.

EROSION IN DRY CREEK

A study conducted by the California Division of Mines and Geology in 1977 identified numerous locations along Dry Creek where significant bank erosion had occurred during the years 1953-1959 and 1959-1975. According to the study, a combination of factors, including mining of instream gravels, watershed fires, major floods, channel modifications, and Warm Springs Dam construction, resulted in about 87 acres being lost during this period to either lateral corrosion or downgrading of the creekbed. Due to a lack of scientific evidence, however, it has been impossible to determine the extent to which each of these factors has contributed to erosion. Significant downgrading (creek bottom erosion) occurred in the vicinity of mining operations at Westside Bridge (17-18 feet between 1934 and 1978) (D.C.R.M. #2.1).

Downgrading and widening occurred below Westside Bridge near the mouth of Dry Creek. Wooden pilings constructed to slow erosion were left suspended above the creek bottom (D.C.R.M. #.4) as later waters moved Dry Creek gravels into the lowered Russian River channel.

Erosion further upstream consisted of both channel deepening and meandering. Over 40 acres were washed downstream from properties between Pine Ridge Creek and Kelley Creek (see map) (D.C.R.M. #3.5-4.5) where thalweg elevations had dropped slightly. Another 30 acres were lost from a one-mile stretch one mile north of Lambert Bridge (D.C.R.M. #8) where the riverbed had degraded locally. According to creek-bed cross-sections surveyed in 1965 and 1974 by the Army Corps of Engineers, much of the Dry Creek channel has downgraded below D.C. River Mile #10 near Yoakim Bridge. However, the most significant downgrading has occurred between the mouth and D.C. River Mile #3.5 near Pine Ridge Creek.

RECREATION

The recreational use of the river environment increased substantially following World War II. The Russian River below Wohler Bridge has been a resort/recreational area since the early 1900's with swimming, fishing, and canoeing the primary activities. However, rapid increases in population growth and improved access meant that more people could enjoy the recreational opportunities along the entire stretch of the river. The Healdsburg Dam and Memorial Beach Park (R.M. #31.8) have provided access to the river for swimming and canoeing for many years. Temporary dams were used from 1905 until 1924, when the first permanent structure was built. The dam structure was undermined in 1942, and the present structure has been in place since 1952. Beginning in the late 1950's, canoe trips were taken from the Healdsburg launch area to points downriver at Wohler Bridge, Mirabel, Guerneville, etc. Swimming and sunbathing also were frequent

STREAMBED ELEVATIONS AND GRADIENTS*

DRY CREEK (In Feet)

Range Number (D.C.R.M.)	1964 Elevation	1975 Elevation	1978 Elevation
2 (14.3)	191.0	188.9	189.6
4 (13.5)	176.8	182.2	181.0
5 (12.8)	170.9	169.1	168.6
8 (11.8)	160.8	163.5	159.1
9 (11.4)	161.7	159.6	160.2
11 (10.7)	154.4	153.3	154.5
13 (10.0)	151.0	145.8	146.3
15 (9.4)	146.6	139.8	137.8
18 (8.3)	133.3	133.1	129.5
22 (7.4)	125.6	122.5	122.0
24 (7.0)	118.9	116.9	--
27 (6.2)	113.2	111.0	--
31 (5.3)	106.6	105.6	--
34 (4.5)	98.8	99.9	96.9
37 (3.8)	96.3	92.2	90.0
39 (3.2)	90.5	82.3	82.4
41 (2.8)	87.9	80.9	--
44 (2.1)	83.2	71.9	70.9
45 (1.2)	--	67.1	67.2
46 (.4)	--	62.2	61.0
47 (0)	--	57.4	55.6

*Based on thalweg elevations surveyed by U. S. Army Corps of Engineers (1964, 1975, 1978).

Year	Distance Surveyed (Miles)	Change in Elevation (Feet)	Gradient (Feet/Miles)
1964	12.2	107.8	8.84
1975	14.3	131.5	9.19
1978	14.3	134.0	9.37

activities at undeveloped recreational sites near Wohler Bridge. River recreation was less formalized in Alexander and Cloverdale Valleys although available wherever access could be attained (Highway 128 Bridge (R.M. #52), Crocker Road Bridge (R.M. #62), and Alexander Valley Road Bridge (R.M. #46)).

COYOTE DAM

Construction of Coyote Dam and Lake Mendocino in 1956-58 and subsequent river channel protection measures (1958-1963) have had a profound effect on the hydrologic characteristics of the Russian River. The project, in addition to dam and reservoir construction, authorized the Army Corps of Engineers to undertake measures to protect streambank stability downstream of the dam as far south as the mouth of Mayacamas Creek at the southerly end of Alexander Valley (R.M. #41). The Corps of Engineers agreed to take responsibility for the construction and maintenance of these bank protection structures for a specified period ending in 1963.

The channel work consisted of several tasks. Channel clearance was accomplished by the removal of all in-channel vegetation within a 400 foot wide swath through Cloverdale and Alexander Valleys. The channel gravels were then uniformly regraded in order to divert the river away from potential erosion problem areas. Various bank protection devices (jacklines, flexible fence, levees, tree pendants, etc.) were also used to stabilize eroded banks and assist in the growth of new riparian vegetation. A "test

reach" was selected north of Geyserville Bridge for various experimental methods of bank protection (R.M. #52-56).

Upon completion of the Corps' work, the river channel had significantly changed. Summer flows were regulated by releases from the dam, changing what was once an occasionally dry riverbed during late summer to one which flowed all year. Winter peak flows were somewhat reduced, limiting the extent of flooding in some places. The riverbed, formerly comprised of several alternative flood channels and backpools, now consisted of a single, well defined, uniform channel. Backpools and riparian vegetation, an important regulator of stream temperature and fishery habitat, were no longer present within the channel, though some regrowth was effected along the edges of the riparian corridor. The levees that were constructed tended to stabilize only those banks that were leveed, while diverting flows against other banks. Jacklines and tree pendants tended to break loose from the banks and roll downstream creating artificial obstructions in the channel.

In 1963, following the Corps' involvement, the Sonoma County Water Agency took over the responsibility of maintaining the existing Corps work. The agency has continued to remove inchannel vegetation, repair and maintain Corps levees, and replace unsuccessful protection devices. Funding for this work has been derived from both agency and federal sources (Public Law #99).

CROSSINGS AND INSTREAM STRUCTURES

A number of stream crossings and other instream structures have been placed in the Russian River channel in the past. Many of these facilities have been constructed in such a way as to have a potential effect on river hydrology. Structures in the study area include the Asti summer road crossing, the Del Rio Woods Dam, the Healdsburg Dam, the Basalt summer road crossings on the Russian River (R.M. #31.6) and Dry Creek (C.D.R.M. #0), and the Wohler Dam.

The stream crossings consist of inchannel gravels bulldozed across the streambed, with either culverts or piers to allow the summer flows to pass. The Asti crossing (R.M. #57.8) has served local farmers for years, while the two crossings near Healdsburg have permitted Basalt Rock Company to transport excavated gravels to its processing plant since the 1940's. In each case, the crossings are allowed to remain in place until winter flows wash them downstream, thus creating a temporary barrier to water and bedload flow.

The Healdsburg and Del Rio Woods Dams (R.M. #35) were constructed in the 1950's to create deep water impoundments for recreational swimming. Each has a permanent section which partially limits bedload movement. The Wohler Dam was built for the purpose of retaining bedload gravels which act as filters at the water pumping stations nearby. These three summer dams have the potential effect of limiting fish migration during particular months, although fishways are built into the Wohler facility.

RECENT HYDROLOGIC HISTORY

Alexander Valley

Since the assumption of river channel maintenance operations by the Water Agency in the early 1960's, few major erosion problems have occurred. Some minor channel meandering has taken place at various locations as the Alexander Valley reach has aggraded over the years. Some degradation has occurred in areas of gravel extraction, while streambed elevations in unmined areas have fluctuated (see table). During the same period, mining operations in Alexander Valley have increased steadily. Freeway construction from Healdsburg to Cloverdale used channel gravels from several locations in Chianti, Geyserville, and Jintown. Beginning in the 1970's, gravel extraction operations began to settle in permanent locations. Presently seven sites (see map) are mined regularly and several additional areas are

under application. The potential effects of these mining operations on the river's hydrology is partly illustrated by the following example.

Geyserville Bridge

Problems with erosion intensified during the winter of 1977-78 in the vicinity of Geyserville Bridge. Two mining operations, one about 1½ miles north of the bridge (R.M. #53.7) and another at the bridge (R.M. #52) were regularly extracting gravels during the drought years of 1976-77. In between were several gravel bars which had not been mined. The winter flows which followed the drought period eroded a point along each bank at the outside of two successive meanders (R.M. #52.3 and R.M. #52.5). A total of about six to eight acres of vineyard and riparian lands was lost and River Road on the east bank was threatened. Emergency measures undertaken by the Water Agency to prevent further damage included the digging of pilot channels and the rip-rapping of the bank along the road. The cost of the work was estimated at \$100,000. Though it is difficult to pinpoint direct causes of such erosion, there appears to be a relationship between the increased velocity (thus, erosive potential) of flood waters where the streambed was lowered and straightened and the obstruction created by relatively high, unmined bars in between. Other factors have also influenced the river's course in this area, including the channel gradient and various bank stabilization measures previously mentioned in this section.

Dry Creek Valley and Middle Reach

Erosion in the Dry Creek Valley in recent years has subsided somewhat. The area above the mouth of Pine Ridge Creek (D.C.R.M. #3.5) has continued to degrade and meander since 1974, suggesting that the "knick-point" in the creek channel may be continuing its upstream migration. Little erosion has occurred below Pine Ridge Creek since the flood of December,

1964. At the same time, Valley residents have continued to armor the banks in attempts to forestall further erosion. Channel widening has not occurred extensively with the exception of the aforementioned stretch between River Miles #3.7-4.8 and 8.1-8.9. During the 1970's, about 30 and 20 acres were lost (respectively) from these two areas.

At Westside Bridge, the 1970's generally saw increased quantities of aggregate materials removed from the streambed. At present, however, removal has been reduced to only a fraction of these previous production levels. Basalt continues to mine in-stream gravel from the Russian River near the mouth of Dry Creek, contributing to the movement of Dry Creek gravels into the Russian River. The construction of Warm Springs Dam and its associated roads, bridges, and support facilities also began in the 1970's. In the last couple of years, construction activities have increased substantially. The erosion of lands denuded by the project has most likely contributed additional sediment to the stream system, though settling basins have recently been built to control some of the erosion during winter flows.

At the river's bend near Healdsburg, local mining has maintained a large channel capacity as far downstream as Healdsburg Dam. At that point, the dam has most likely had a stabilizing influence on the upstream gradient. The dam, in combination with the minint at the bend and in Alexander Valley, has substantially reduced bedload flow into the Middle Reach from Russian River gravel bars upstream.

Downstream, the majority of the mining operations moved from the channel to the alluvial terraces in the late 1960's. Streambed elevations have not as yet returned to premining levels. Disruption of the stream channel and its banks has also occurred in the vicinity of Wohler Bridge. Regular maintenance of the Wohler pumps involves removal of local vegetation for the purpose of preventing silt buildup near the filtering gravels.

Terrace mining adjacent to the river channel has also affected the river's hydrologic characteristics. Levees constructed between the terrace pits and the live channel have narrowed and straightened the river's alignment, increasing stream velocity and erosive potential. Levee erosion often requires that the mining operations along the river take steps to prevent diversion of flows into the pits. Terrace extraction has also affected local flooding in the Middle Reach area. Removal of thousands of cubic

TABLE II. B-2.
CHANGE IN STREAMBED ELEVATION* AND GRADIENT

<u>MIDDLE REACH</u> <u>RUSSIAN RIVER</u> (In Feet)			
<u>River</u> <u>Mile</u>	<u>1940</u> <u>Elevation</u>	<u>1972</u> <u>Elevation</u>	<u>Change</u>
23.2	37.5	30.5	-7.0
24.1	37.5	31.5	-6.0
25.1	43.6	33.1	-10.5
25.7	48.7	35.0	-13.7
26.8	55.0	36.5	-18.5
27.7	53.0	37.3	-15.7
28.7	58.8	43.7	-15.1
29.7	59.5	52.1	-7.4
31.4	61.0	59.6	-1.4

* Based on thalweg elevations from surveys conducted by U. S. Army Corps of Engineers: 1940, 1972.

TABLE II. B-3.

CHANGES IN STREAMBED ELEVATION AND GRADIENT

ALEXANDER VALLEY

RUSSIAN RIVER

Year	Distance Surveyed (Miles)	Change in Elevation (Feet)	Gradient (Feet/Miles)
1940	8.2	23.5	2.9
1972	8.2	29.1	3.6

yards of alluvial materials has created additional flood storage capacity, thereby temporarily lowering local flood levels on surrounding lands.

Bedload movement in the Russian River watershed occurs largely during periods of high flow. In general, as peak flows rise, increasingly larger bed particles are displaced increasingly greater distances downstream. Finally, riparian acreage has been significantly reduced by terrace operations adjacent to the river channel.

Bedload and Sediment Transport and Water Quality

In 1971, the Sonoma County Water Agency began a study, commonly known as the "Einstein Report", which attempted to estimate the rate of bedload flow in portions of the Russian River. Based on a series of cross-sectional surveys, aerial photographs and subsequent calculations, the study's initial estimates of bedload replenishment over an eight-year period were 57,000 tons/year in the Alexander Valley and 14,000 tons/year in the Middle Reach. The discrepancy between these two figures may have several contributing factors, including inchannel obstructions, erosion of watershed lands, streambank stability, etc. However, annual surveying of the channel undertaken by the Einstein Study seems to indicate a buildup of inchannel gravels in some locations in Alexander Valley. On the other hand, Corps of Engineers surveys taken in the Middle Reach indicate that replenishment has not yet brought

River Mile	1940 * Elevation	1972 Elevation ⁰	1975 Elevation ⁰	1978 Elevation ⁰
41.2	119.2(42.0)	117.5	122.0	119.5
46.0	145.0	146.5	145.5	143.5
49.8	179.0(49.7)	178.5	178.0	176.5
50.2	--	178.5	181.5	179.5
50.5	183.4(50.7)	183.0	182.0	179.5
51.0	--	187.0	185.0	184.5
52.0	193.0	190.5	191.0	188.5
56.8	234.0	234.5	237.0	233.0
62.0	283.0(61.9)	280.0	277.0	272.5
63.8	290.0(63.3)	296.0	297.5	299.0

* Based on thalweg elevations from surveys conducted by U. S. Army Corps of Engineers (1940).

⁰ Based on thalweg elevations from surveys conducted by the Sonoma County Water Agency (1971-1978).

Year	Distance Surveyed (Miles)	Change in Elevation (Feet)	Gradient (Feet/Miles)
1940	22.6	170.8	8.0
1972	22.6	178.5	7.9
1975	22.6	175.5	7.7
1978	22.6	179.5	7.9

the stream bottom up to its pre-mining level.

Water in the Russian River basin has been described by the Department of Water Resources (1977) as "generally of excellent to good quality". Problems have occurred with excessive turbidity, excessive phosphate content, and lowered dissolved oxygen content. The latter two conditions in the Russian River below the Mark West Creek confluence have been improved by efforts to eliminate wastewater discharges from the Santa Rosa area. The primary cause of excessive turbidity has been identified as the erosion of watershed land during the rainy season. This is especially true in the Dry Creek basin which has generated approximately 5,700 tons of sediment per square mile per year (Ritter and Brown, 1971). Other factors contributing to sediment transport identified by Ritter and Brown and the Department of Water Resources (1977) include sand and gravel extraction and regulated releases from Lake Mendocino storage. During high water periods, the turbid flow release from the lake is gradually increased until the reservoir is at capacity. Between storms water is then released gradually, prolonging the turbid conditions downstream. As the river levels subside further, the suspended sediments are deposited along the channel bottom, reducing stream bottom permeability and fishery spawning habitat.

Instream gravel extraction such as that which occurred in Dry Creek at Westside Bridge and in the Russian River south of Healdsburg had a similar effect on river quality and sediment transport. D.W.R. (1977) concluded:

"The gravel pit extraction and refilling process results in the replacement of highly permeable river gravels with a mixture of materials probably having a rather low ability to conduct water. This greatly reduces the subsurface flow capacity of the stream. In areas below the pits the deposition of fine

materials tends to seal off the bottom of the channel and reduces recharge of stream-flow to adjacent aquifers."

Turbidity also resulted from the direct disturbance of the streambed by the dredging operations.

Other indicators of water quality which have been measured in the past include electrical conductivity for mineral concentration (hardness), pH, dissolved oxygen concentration, temperature and alkalinity. Russian River water had been determined as Class I (excellent to good--D.W.R.) irrigation water for all parameters but boron concentration before 1958. Dillution with additional flow from Coyote Dam brought the boron levels down to Class I standards. High dissolved iron concentrations have been present during summer months due to the release of anaerobic water from the bottom of Lake Mendocino. River pH falls in the slightly basic to neutral range (7.2-8.8). Dissolved oxygen saturation levels were less than adequate until 1975 (as low as 63%--D.W.R.) below Mirabel Park due to the above-mentioned wastewater discharges. Since the discharges were discontinued, d.o. levels have stabilized at a relatively higher level. Upstream d.o. levels are generally good. However, when floodwaters are carried into the pits, through levee failures and/or overtopping of the levees, suspended sediments are deposited, decreasing groundwater transmissivity through the aquifer.

II.C.

DESCRIPTION OF EXISTING ENVIRONMENT:

ALEXANDER VALLEY MIDDLE REACH DRY CREEK VALLEY

NATURAL CHARACTERISTICS

1. Slope and Geology (Refer to map of "Geology and Aggregate Reserves" in Section III.)

The Russian River and Dry Creek flow through northwest trending valleys of the Northern Coast Ranges. The valleys have generally developed along fault traces or in less resistant parallel rock formations. The Alexander Valley on the east and Dry Creek Valley and the Middle Reach on the west are bounded by ridges consisting of rocks of the Franciscan Formation and Great Valley Sequence. This relatively unstable unit is a melange of metamorphosed sandstones and shales with intrusions of igneous and serpentine rocks.

The ridge separating the Dry Creek and Alexander Valleys (see map on page 15) consists of parts of the Franciscan Formation, Glen Ellen Formation, and Dry Creek Conglomerate. The Glen Ellen unit consists almost entirely of sandstone, mudstone and tuffs, while the Dry Creek Conglomerate is a mixture of massive, sheared cobbles. Also present in these rock units are the Healdsburg and Lytton faults, also paralleling the northwestern orientation of the valleys.

Basaltic flows and rhyolite breccias of the Sonoma Volcanics group occur along valley ridges in various locations. Bordering Alexander Valley Road on the

southwest side of Alexander Valley is one large outcropping. Another is located west of Foreman Lane near the Middle Reach of the river. Glen Ellen Formation rocks comprise large portions of the southern end of Alexander Valley and the ridge topographically separating the Middle Reach from Windsor and the Santa Rosa Plain to the east. A small zone of Merced Formation sandstone occurs at the southern end of the Middle Reach.

River terrace deposits, consisting of relatively older, elevated alluvial materials, occur along the outer edges of the valley floors. The "Geology and Aggregate Reserves" map outlines the surface exposure of these deposits within each of the valleys. The City of Healdsburg overlies one of the larger terrace deposits which extends to the north along Dry Creek Valley and south to the Russian River at River's Bend.

The upland geologic units contribute sediment and bedload to the Russian River and Dry Creek as each follows a meandering course through the valleys. The streams have deposited and eroded sands and gravels over the years, resulting in alluvial deposits of varying age. These fluvial materials are known as Younger Alluvium and Stream Channel Deposits, and they comprise the largest geologic unit in the mapped study area. The Stream Channel Deposits are mostly sand and gravel with some silt, while the Younger Alluvium is similar but characterized by a slightly higher portion of silt and clay.

In general, each of the valleys is a broad, flat plain overlying these alluvial deposits. However, several areas are traversed by the streams where resistant bedrock materials occur close to the land surface. In the Alexander Valley, the Russian River passes through three of these areas. Cloverdale Reach is constrained by levees constructed during the 1930's along both banks. Geologic formations constrain the river in the other two locations, from

Asti to Chianti and south of the Alexander Valley Road Bridge. Surface exposure of bedrock near Lambert Bridge influences the streambed in Dry Creek. In the Middle Reach, the Russian River flows into the narrow canyons near Wohler Bridge prior to resuming its course to the ocean.

Slopes in the study area are generally flatter than 5%. Slopes in excess of 30% occur in the upland terrain along the ridges bordering Alexander and Dry Creek Valleys and the western side of the Middle Reach. The low-lying ridges east of Eastside Road and north of Healdsburg, and the lower foothills along the edges of the valley floors generally range from 5% to 30% slopes.

2. Soils

Soils of the valley floors are predominantly of the Yolo-Cortina-Pleasanton Association. They are well to excessively drained and occur on the level to nearly level slopes of flood plains, alluvial fans and low terraces along streams and other drainageways. The erosion of upland sedimentary, metamorphic, and igneous rock units has contributed to their formation.

Yolo soils are generally the best suited of the soils in this association for crop production. Storie Index^{*} ratings for these types are often perfect (100) or near perfect. Yolos are well-drained and have a surface layer of loam, overlying a stratified loamy substratum.

Pleasanton soils are similar to the Yolo soils, although occasionally limited by relatively slow subsoil drainage. They are well suited for crop production and are well-drained. Storie Index ratings are normally Grade I in the high 80's and low 90's. Soil class, according to the Soil Conservation Service capability unit rating system, is usually I or II.

Cortina soils are highly permeable, occurring in areas between prime soils and the exposed gravel bars of the streambeds. The rapid drainage which takes place in Cortina soils is their only limitation for crop production, requiring additional irrigation in the dry months. S.C.S. rates them as Class IV. Storie Index ratings are generally in the 50's (Grade III).

The association normally consists of 60% Yolo, 15% Cortina, 15% Pleasanton, and 10% from minor soils of the Arbuckle, Manzanita, Pajaro, Positas, and Zamora series. In the Alexander Valley, though, the coarser nature of the alluvial materials has resulted in a higher incidence of Cortina soils in the association, especially in the Cloverdale area.

Most of the other soil types in the study areas are those which form on steeper slopes. In the Alexander Valley, Cole and Clear Lake series are found on footslopes or terraces at the edge of the basin, especially west of the Alexander Valley Road Bridge and in the vicinity of Jintown. They are usually "prime" soils, although limited somewhat by inconsistent drainage, flooding, and difficulty in tillage when wet. Storie Index ratings are usually Grade III between 40 and 60.

Upland soils in the Alexander Valley are almost entirely Class III through VI (S.C.S.). Clough, Haire, Henneke, Hugo, Josephine, Laughlin, Los Gatos, Sobrante, and Spreckels, Steinbeck, and Suther series have formed on the unstable Franciscan sandstones and shales. Limitations on crop production from these soils stem from the steepness of slopes and resultant high erosion potential.

The Franciscan geology west of the Dry Creek Valley has developed soils primarily of the Boomer, Josephine, and Suther series. The Stonyford, Sobrante, and Montara series are also present in smaller

^{*}See Topical Issues: Agriculture

amounts. East of Dry Creek are Los Gatos, Suther, Haire, and Clough series soils. The Yorkville-Suther Association predominates the area west of Westside Road, while east of the Middle Reach is the Spreckels-Felta Association. Both associations are well-suited for range and pasture.

Two "soil" types are associated with stream channels. Alluvial lands and riverwash soils are exposures of sand, silt, clay, and gravel which are not suited for crop production. Alluvial lands are classified under capability unit VII and frequently support riparian vegetation. Riverwash lands occur within the channel itself and are subject to frequent erosion and deposition.

Accompanying maps and charts present information and data on soil classes (S.C.S.) within the study area. Storie Index ratings generally confirm the S.C.S. classifications. Additional discussion of soil productivity in the three valleys is included in the section on Topical Issues: Agriculture.

3. Hydrology and Water Quality

The previous section on the hydrologic history of the Russian River watershed presents a detailed summary of the natural and cultural events which have influenced river hydrology over the last four decades. The following text describes the existing hydrologic conditions of each of the valleys' streams.

Surface Hydrology

The Russian River drains a 1,485 square mile watershed in Mendocino and Sonoma Counties, flowing through the Alexander Valley and Middle Reach study areas. Dry Creek, its largest tributary, flows southward through Dry Creek Valley, joining the Russian River in the Middle Reach south of Healdsburg. The Russian River summer channel consists of the live stream (augmented by releases from Lake

Mendocino) which meanders bank and forth between exposed gravel bars of varying dimension. Bordering most of the channel on each side and separating it from adjacent cultivated land is a corridor of riparian vegetation. In some locations, adjacent lands have been denuded of the streamside vegetation either by erosion or conversion for other uses. (See Hydrology Map, Section II.) Young, pioneer riparian growth appears in random locations on the gravel bars.

Winter storms bring heavy rainfall to the basins and flood water inundate the valley floors. First, the channel itself is filled to a "bankfull" condition, then, depending on the intensity of the storm, is overtopped as waters spread over the flood plain. Occasional swales or auxiliary channels exist on farmlands alongside the main channel which provide intermediate drainage of floodwaters. During peak flows of major storms, bedload gravels are moved downstream and later redeposited as the flow recedes, forming new bar configurations.

Several factors combine to determine the quantity and rate of bedload movement within the stream channels. The major factors are stream velocity or discharge, channel geometry and gradient, and particle size and shape. Discharge, measured in cubic feet of flow per second, is monitored at several U.S.G.S. gage stations within the basin. It varies with the intensity and duration of precipitation in the watershed. Channel gradient, or change in streambottom elevation over distance, is another hydrologic characteristic which influences gravel movement. In general, the steeper the slope of the channel, the higher the stream velocity and the greater the potential for bedload movement. In most river systems, the channel slope gradually flattens as the river approaches the ocean. In this way, relatively large particles can be moved by the lower discharge of tributary streams, while the larger loads in the lower reaches of the river require a greater amount of discharge to move them.



Match Line Map A-2



STREAM



CLASS VI, VII VIII (OUTSIDE RIPARIAN CORRIDOR)



RIPARIAN VEGETATION



CLASS I, II



CLASS III, IV

Russian River, Alexander Valley Cloverdale Section Map A-1

SOILS

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
0 900 1800 Meters



STREAM



CLASS VI, VII VIII (OUTSIDE RIPARIAN CORRIDOR)



RIPARIAN VEGETATION



CLASS I, II



CLASS III, IV

Russian River, Alexander Valley Geyserville Section Map A-2

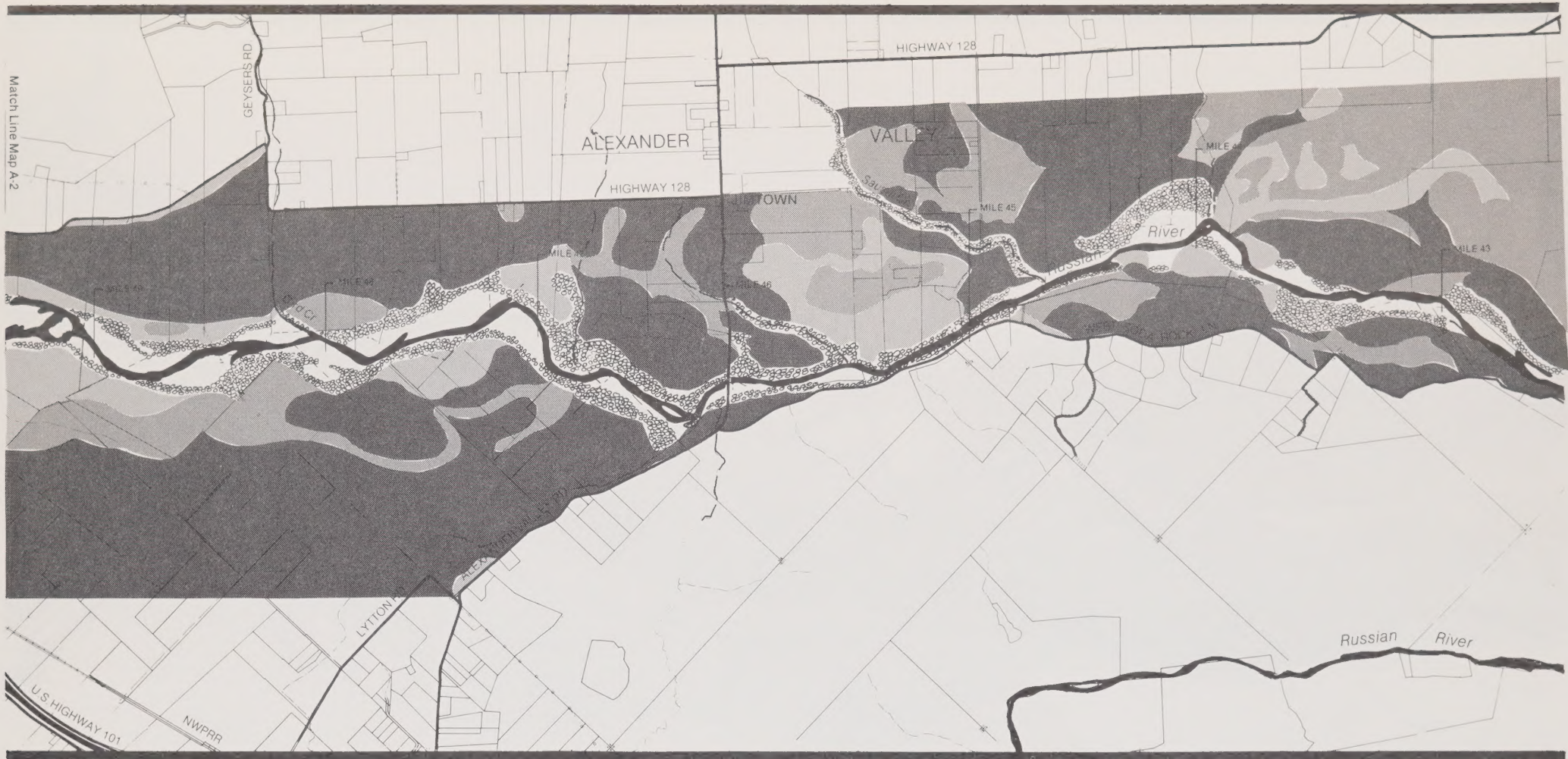
SOILS

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



North

Scale 0 3000 6000 Feet
0 900 1800 Meters



STREAM



RIPARIAN VEGETATION



CLASS I, II



CLASS III, IV



CLASS VI, VII VIII (OUTSIDE RIPARIAN CORRIDOR)

Russian River, Alexander Valley Jimtown Section Map A-3 SOILS

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
0 900 1800 Meters



Match Line Map B-2



STREAM



CLASS VI, VII VIII (OUTSIDE RIPARIAN CORRIDOR)



RIPARIAN VEGETATION



CLASS I, II



CLASS III, IV

Dry Creek, Dry Creek Valley Yoakum Bridge Section Map B-1

SOILS

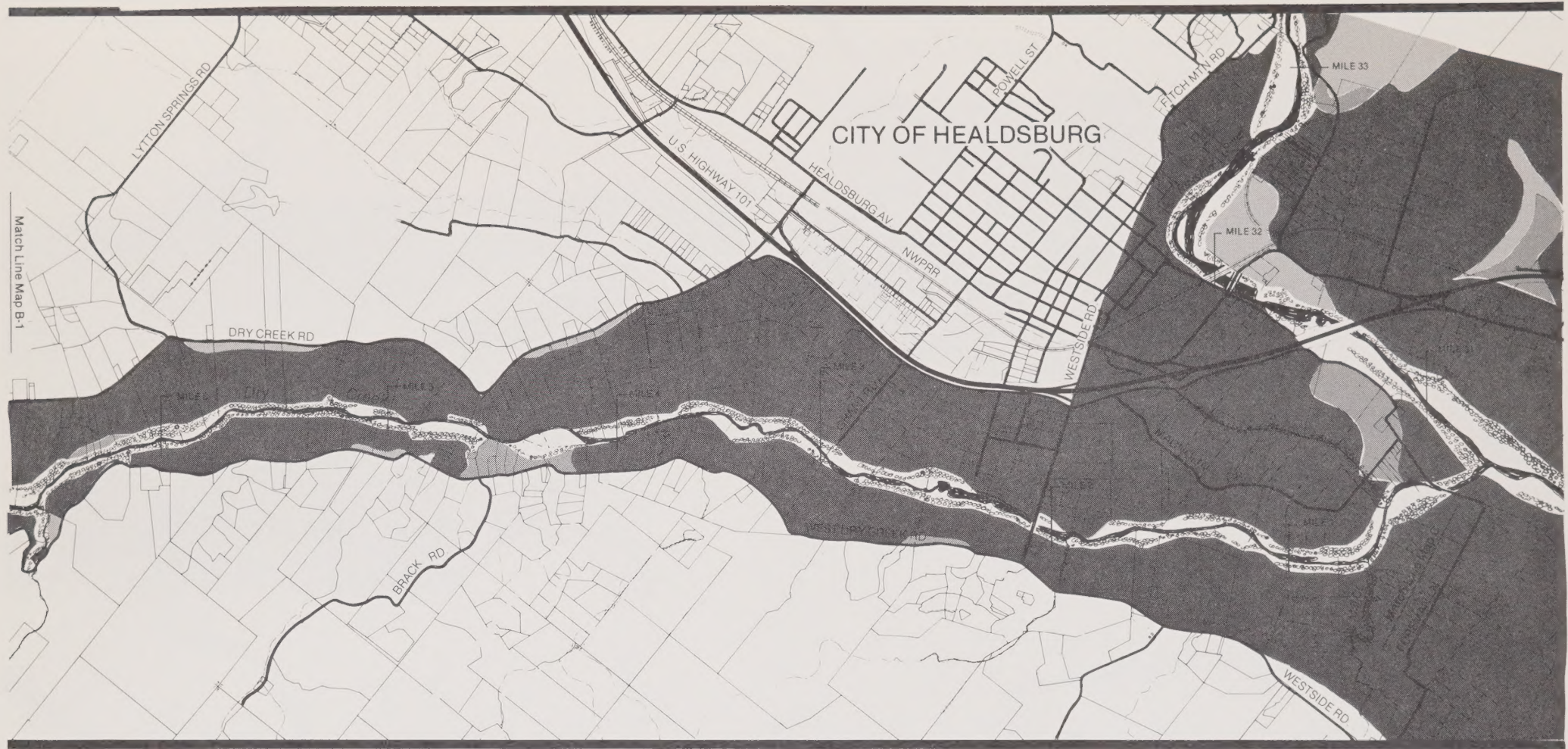
Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



North

Scale 0 3000 6000 Feet

0 900 1800 Meters



Match Line Map B-1



STREAM



CLASS VI, VII VIII (OUTSIDE RIPARIAN CORRIDOR)



RIPARIAN VEGETATION



CLASS I, II



CLASS III, IV

Dry Creek, Dry Creek Valley Healdsburg Section Map B-2

SOILS

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
0 900 1800 Meters



STREAM



CLASS VI, VII VIII (OUTSIDE RIPARIAN CORRIDOR)



RIPARIAN VEGETATION



CLASS I, II



CLASS III, IV

Russian River, Middle Reach Map C

SOILS

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
0 900 1800 Meters

TABLE II. C-1
CHANNEL GRADIENT
ALEXANDER VALLEY CHANNEL

Total Reach	(R.M. #63.8-#41.2) = 8.0' per mile
Upper Reach	(R.M. #63.8-#52) = 9.4' per mile
Lower Reach	(R.M. #52-#41.2) = 6.4' per mile

Source: Sonoma County Water Agency, 1978

Alexander Valley

Tributary streams feeding the Russian River in the Alexander Valley include Big Sulphur, Icaria, Barelli, Gill, Miller, Gird, and Sausal Creeks. Other intermittent streams which once drained the terraces along the outer edges of the valley floor have been channelized in the past for irrigation and flood control purposes. The slope of the Russian River channel changes significantly in the vicinity of the mouth of Gill Creek. Table II.C-1 shows that upstream of Gill Creek the slope is relatively steeper than it is through the broad flat plain below.

Of course, the actual gradient of the channel over short distances varies somewhat from these regional estimates. Some surveyed locations (Sonoma County Water Agency; U. S. Army Corps of Engineers) show buildup in the channel while others indicate a downgrading trend. In fact, bars in some locations have risen near to or above the elevation of the streambank. Although adequate channel data over the entire Alexander Valley reach is not available, these gross estimates give a reasonable indication of gradients over the longer reaches.

The change in gradient occurring in the vicinity of Gill Creek appears to be substantiated by the local

geology. The resistant bedrock units close to the channel through Asti and Chianti have probably contributed to the "braided" character of the live stream through that reach. At Gill Creek the stream begins to meander laterally over a wider area, coinciding with the beginning of the broad, flat, flood plain of lower Alexander Valley.

Channel alignment, or meander, varies frequently throughout the Alexander Valley reach. Geologic factors, gradient, and bank protection measures conspire to give the channel some relative stability along several stretches of the river. Resistant geologic formations stabilize the channel's alignment not only in the reach upstream of Gill Creek, but also through the stretch between the Alexander Valley Road Bridge and Sausal Creek (R.M. #44.9). In addition, several miles of streambed above Cloverdale in Mendocino County are constrained by bedrock near the channel. From Big Sulphur Creek to the Cloverdale Airport, both channel banks were heavily armored by levee construction during the 1930's. The reach has been remarkably stable since then, with only minor bank works having been required.

The remainder of the channel in Alexander Valley, primarily the reach between Gill Creek and the Alexander Valley Road Bridge, has been less stable in alignment. The deep alluvium in this stretch is more erodible and the potential for lateral meander is greater. Channel alignment has been maintained to some degree by in-stream mining activities and occasional levees. However, active bank erosion continues in various locations, threatening both riparian vegetation and agricultural lands.

Dry Creek and Middle Reach

Fall, Dutcher, Pena, Grape, Crane, Kelley, Pine Ridge, and Mill Creeks are the tributary streams feeding Dry Creek between the Warm Springs Dam site and the Russian River. Dry Creek itself draws about 218 square miles of watershed before it meets the Russian River near Healdsburg. Porter Creek (R.M. #23.5) and

several intermittent tributaries also join the Russian River in the Middle Reach. Most of these smaller creeks have been altered by past human activities in the watershed and presently function mainly as drainage ditches for floodwaters. Riparian growth along their banks has been cut for channel construction or cultivation, or undercut by the lowered streambed.

The Dry Creek channel is much narrower than the Russian River channel in either Alexander Valley or the Middle Reach, due in part to the smaller watershed, lower discharge and steeper gradient. In the lower reaches it is much deeper as well, due to the recent downgrading of its bed. The upper reaches of the channel meander somewhat, tending toward the east side of the valley, while the lower portion below Lambert Bridge is fairly straight. The live summer flow meanders within the gross channel as well, though the "wavelength" of each meander is neither well-defined nor pronounced. In fact, Cleveland and Kelley (1977) suggest that Dry Creek may be a "braided" stream with only a few, poorly-formed meanders, although some isolated areas may be approaching the threshold gradient for a meandering stream. Just upstream of Mill Creek (D.C.R.M. # 1.0), the straightened configuration ends and the channel veers to the northeast before it enters the Middle Reach channel.

The Russian River flows southward and westward around Fitch Mountain and into the Middle Reach at Healdsburg before making an abrupt turn to the south at River's Bend. The channel orientation is north/south through the entire reach. From River's Bend (R.M. #32.2) to a point about 1.5 miles downstream of the Dry Creek confluence (R.M. #30), the channel is very straight. At R.M. #30, a wide, sweeping meander to the east occurs before the channel once again straightens. From R.M. #25 to Wohler Bridge, the river makes an "S" turn, flowing west then south again until it picks up its westward course to the ocean.

The channel is significantly deeper than in the Alexander Valley. Gravel bars present in the Middle Reach

channel are also much lower relative to the height of the banks and the summer stream flow. This condition of high banks and low bars, combined with a narrow, straight channel, more closely resembles the gross hydrological conditions in Dry Creek than those in Alexander Valley.

Riparian vegetation borders Dry Creek for most of its length below the dam site. However, several areas have been denuded by streambank undercutting. The riparian corridor is relatively narrow, due in part to clearing over the years for cultivation, though much of the present growth exists in a relatively mature stage.

Riparian growth in the Middle Reach is sparse along the west bank levee and in the Healdsburg area largely because of local mining and farming activity. Further south toward Wohler Bridge, isolated areas of dense riparian still exist along both banks, but between them, terrace extraction activities have reduced the amount of vegetation. The inchannel gravel bars in the Middle Reach also support an abundant population of young, pioneer riparian growth, especially the lower portion of the study area.

The hydrologic processes of bedload and sediment load movement described earlier apply to Dry Creek as well. Earlier studies (Ritter and Brown, 1971; Cleveland and Kelley, 1977) have shown that the Dry Creek watershed generates a significantly higher sediment load per acre of watershed than does the Russian River or any of its tributaries. This is due, in part, to the steep slopes of the upland terrain. However, the logging and grazing (controlled burning) activities are probably the most important contributors to sediment load in Dry Creek and the Middle Reach.

The gradient of the Dry Creek channel has changed rapidly during the last few decades, especially in the lower half of the valley. Generally, though, the channel has developed two gradients, separated by inchannel bedrock exposed in the vicinity of Lambert Bridge (D.C.R.M. #7). Above

the bridge, the channel has remained steep and maintained its overall gradient, though thalweg elevations at particular locations have fluctuated somewhat. The gradient of the upper reach of Dry Creek (Lambert Bridge to Bord Bridge) was the same in 1964 and 1975, although both elevations dropped slightly. (See Table II. C-2.)

TABLE II. C-2 CHANNEL GRADIENT
(in feet per mile)
DRY CREEK

Reach	1934	1964	1975
Total (D.C.R.M. #14-#2)		8.8	9.4
Upper (D.C.R.M. #14-#7)		9.9	9.9
Lower (D.C.R.M. #7-#2)	6.3 ¹	7.3	9.0

¹It is assumed that the 1934 and 1964 Lambert Bridge elevations were equal.

Source: U. S. Army Corps of Engineers
Sonoma County Water Agency

The normal flattening in downstream gradient that existed in Dry Creek at the time of the construction of Westside Bridge in 1934 no longer exists today. The gradient in the lower reach increased from 6.3 feet per mile in 1934 to 7.3 feet per mile in 1964. By 1975, the gradient had steepened to 9.0 feet per mile, or almost as steep as the slope in the upper channel. Present gradients are about 10 feet per mile in the upper reach and 9.5 feet per mile in the lower reach.

Based on the field observations of residents and mining employees, the Russian River channel in the Middle Reach has remained fairly stable in recent years. Surveys taken by the Corps of Engineers in 1940 and 1972 showed that the gradient below the Healdsburg Dam area (8.2 miles) had steepened from 2.9 to 3.6 feet per mile

over the 32-year period. Some of this increase may be attributable to the mining of the reach between Dry Creek and Wohler Bridge during the last three decades. Although streambed elevations have not yet reached premining levels, they appear to have stabilized somewhat. This recent stability may be a result of both ongoing mining activities and the presence of the Healdsburg Dam. The dam may be functioning as a grade stabilizer for the upstream channel and slowing the replenishment of downstream bar deposits. In addition, occasional extraction at Healdsburg, heavy mining activities in the Alexander Valley, and bedrock exposures near Mayacamas Creek may be reducing bedload movement out of Alexander Valley and above the Healdsburg Dam.

Channel alignment has also been stable in the Middle Reach, although various points along the maintained channel are frequently subject to erosive floodwaters. The west bank levee, though fairly stable over most of its length, is vulnerable in places to erosion, especially the section below the Dry Creek confluence. Regular efforts are made by Basalt Rock Company to reinforce the levee against storm flows. Other points downstream are also vulnerable, including the levees separating the terrace pits at R.M. #25 and #26.3, the outside of the western bend in the river at R.M. #25, and the low terrace to the northeast of Wohler Bridge.

In Dry Creek, the downgrading of the channel below Lambert Bridge has increased the gradient and reduced the likelihood that lateral meander will occur. However, the channel may continue to widen by scouring and undercutting its banks. Above Lambert Bridge, localized zones of relatively gentle gradient have experienced some meandering and channel widening, but most of the channel has been relatively stable. Banks in many areas have been armored with car bodies, brush, gravel, riprap, or other objects.

The capacity of the Dry Creek and Russian River channels to carry flood flows through and out of the valleys has in-

* Some of this increase may be due to the construction of the dam between the two survey dates.

creased over the last few decades. Increased flows within the channel generally reduce flow outside the channel for any one storm. At the same time, concentration of the flow may increase the erosive potential of floodwaters both in and out of the main channel. Presently, Dry Creek and the Russian River flow within straightened, deepened channels with relatively steep channel slopes. Flood flows from any one storm will be more likely to stay within each channel, reducing the flooding of surrounding farmlands to some degree. The closure of Warm Springs Dam within the next few years will reduce peak flow discharges as well.

The accompanying table shows the pre-dam streambed, streambank, and 10 and 100 year flood elevations for several points along the Middle Reach of the Russian River between Dry Creek and Wohler Bridge. Notice that the points nearer to Healdsburg (R.M. #28.7 and #29.7) can fully contain the expected ten-year flood within the banks. (U.S.G.S. bank elevations are relatively imprecise.)

Groundwater

Geologic evidence indicates that much of the valley flood plains overlie large unconfined aquifers. The aquifers are recharged by upland flow, percolation through the flood plain soils, and/or subsurface streamflow. In these areas, exchange of flow between river and aquifer is fairly rapid due to the high permeability of the subsurface gravels. The presence of excessive amounts of clay and silt in sedimentary layers can create barriers to this flow. The lack of reliable data makes it difficult to map in accurate detail the exact boundaries of the most permeable portions of the aquifer or the impermeable layers which inhibit recharge. The map of aggregate reserves in Section III shows "primary reserves" areas which can be considered the gross boundary of each valley aquifer.

TABLE II. C-3

MIDDLE REACH CHANNEL

River Mile	Thalweg Eleva- tion (1, 2)	Bank Eleva- tion (1, 3)	Flood Elevation (1, 2)	
			10 yr.	100 yr.
(Wohler Bridge)				
#23.0	29'	40'	69'	77'
#24.1	31'	55'*	70'	78'
#25.4	34'	60'	71'	78'
#26.8	36'	65'*	71'	78'
#27.8	38'	70'	71'	79'
#28.7	47'	75'*	72'	79'
#29.7	52'	80'	77'	83'

* Elevations are approximate.

Sources: (1) U. S. Army Corps of Engineers
(2) Department of Housing and
Urban Development
(3) U. S. Geological Survey

Alexander Valley

The groundwater basin in the Alexander Valley has an estimated storage capacity of 495,000 acre feet (D.W.R., 1975). It is characterized by generally coarse gravels underlying the lands adjacent to the Russian River and relatively high clay con-

tent in portions of the upper terraces away from the river. The aquifer recharge area associated with Sausal Creek is one exception. The bottom of the basin is thought to be V-shaped from the stream cutting action prior to the Pleistocene Epoch. Estimates of the depth of the aquifer are difficult, but probably do not exceed 50 feet in many places. Bedrock outcroppings in the valley near Chianti and Jintown limit the basin size and flow in those areas. Water table levels vary considerably from as little as 10 feet near the river to 60 feet in some of the upper level terraces.

Dry Creek and Middle Reach

The basin which underlies Dry Creek Valley and the Middle Reach generally contains a slightly smaller average particle size than does the Alexander Valley basin. Well drillers' reports indicate that the younger alluvial areas along the stream channels also seem to have less clay and silt present.

A few residents of the valley areas have reported drops in the elevation of the groundwater table during the last few decades. Increased pumpage for irrigation and streambed degradation are both likely contributors to this problem. Present estimates of the depth to groundwater are based on field observation, geologic inference and well drillers' reports. In Dry Creek Valley, the water table ranges from 5 to 20 feet below the land surface in the upper reach and 10-30 feet in the lower reach. Cardwell (1965) estimated groundwater levels in Dry Creek at 5-10 feet in depth. Middle Reach levels appear to be over 20 feet below land surface around the terrace pits. Well drillers' reports in the area vary from 13 to 31 feet in depth with no apparent correlation between proximity to the river and depth to water.

Basin storage capacity is more difficult to estimate in the Dry Creek and Middle Reach. The basin extends to the southeast toward Santa Rosa and only the gross estimates of storage were made by D.W.R.

(year 1975). The estimate was over one million acre feet in Dry Creek, Healdsburg, and Windsor and over 16 million acre feet for the entire basin. The depth of the alluvium in the Middle Reach is probably greater than that of the Alexander Valley. A couple of well reports show alluvium at well over 100 feet, but some show bedrock at less than 100 feet. Clay, or hardpan, layers are also present in the Middle Reach. It is evident from the mining of the terraces that some clays occur at about 55 feet in depth in the southern half of the valley, but this is not the case near Dry Creek.

The basin in the Middle Reach has been altered by past sand and gravel extraction. Aquifer gravels have been removed from over 200 acres of the basin. Groundwater flows into the pits, filling the newly-created space. Sediment flow from flood waters and processing wastes as well as runoff from adjacent farmlands have lined the pits with a layer of silt and mud, thereby inhibiting groundwater flow.

Groundwater (Refer to "Hydrologic History" for additional water quality discussion.)

Groundwater quality in Sonoma County was investigated in 1975 by the State Department of Water Resources. Water from about 20 wells in the Alexander and Dry Creek Valleys was tested for various chemical parameters. Groundwater in both valleys was determined to be of excellent quality for irrigation purposes. Magnesium bicarbonate water was present in lower Dry Creek and the Alexander Valley around Jintown. Calcium bicarbonate water was found in the Alexander Valley south of Geyserville. Hardness was found to be mostly in the "moderately hard" range (100-200 mg/liter) for both valleys with the area south of Geyserville having water in the "very hard" range (+500 mg/liter). Some boron concentrations in excess of the 0.5 mg/liter range were found near Jintown. No wells in the Middle Reach were studied.

Surface water quality is presently being monitored in the Russian River by the North Coast Regional Water Quality Control Board. Periodic testing has been undertaken since 1973 at various points along the river for 16 different parameters of water quality. To date, no problems exist with surface water quality within the study area itself, although wastewater discharges into the river have been a problem downstream in the past. Turbidity and suspended sediment remain the most severe potential problem, however, in the valleys.

4. Vegetation and Wildlife Habitat

The biological environments along Dry Creek and the Russian River have been altered significantly by past human activities. The extent of forests along the banks have been reduced; the natural migration of the river channel has been restricted; and the channel has been deepened in several places. Furthermore, the quality of the sediments in the channel has been altered such that more fine grained materials are near the surface. As a consequence, the quality of the streams as sport fisheries for salmonids has been degraded to the point where waterways within the study area serve only as throughways for migrating salmonid fish. A number of non-sport species dominates the resident population.

There are sections of terrestrial vegetation, however, where remnants of the existing native plant communities still exist. The most important of these have been mapped, but it should be understood that a change in management practices could result in a restoration of the quality of these habitats throughout the study zone. Restoration of the fishery habitat is more problematical because it depends much more heavily on management practices beyond the confines of the study area, and because the problem of fine-grained sediments is affected by a complex set of factors.

The importance of the riparian habitat -

The word "riparian" is used by biologists to describe the entire set of plant and animal associations that result from the existence of rivers and streams. Riparian environments in their natural state contribute more to the biological diversity of a given region than any other element. A 1965 report by the California Department of Fish and Game found riparian forests to "provide living conditions for a greater variety of wildlife than any other" of the 29 habitat types described. Such high diversity results primarily from three factors:

- (1) The physical environment of the riverine system is constantly changing in such a manner as to establish a number of zones with different conditions of substratum and subsurface moisture to which different plant species are adapted.
- (2) The continuously changing course of the river under natural conditions means that plant communities exist in varying states of maturity. Each stage has somewhat different characteristics.
- (3) The mature riparian forest contains several distinct layers in its canopy, each with characteristic bird species. The populations of insects in these forests are also large, supporting large populations of breeding birds and, under ideal conditions, fish populations within the river.

A measure of the importance of the riparian habitat is seen in the species list (Appendix 270 species of plants were identified, many of which are not found outside of the riparian zone. 108 species of birds were observed, or are known to exist in the area, 83 of which demonstrated

strong evidence of nesting. Of these, eight have a primary affinity for riparian habitat and rarely nest elsewhere. A number of the 15 butterfly species observed are restricted to riparian host plants. Eight common amphibians and reptiles were observed, and the presence of 20 species of mammals was indicated by sight, sign, or recent reportings. These include the mink and river otter, exclusively riparian mammals. Within the stream in the study area are found 38 species of fish, of which 18 are native to the system.

Of the animal species identified, none is officially classified as rare or endangered. The California yellow-billed cuckoo, however, was historically present and is a rare species. Its demise in the State was due to the destruction of willow-cottonwood riparian forests. Restoration of these forests in this study and elsewhere is essential for the return of this species to healthy population levels. In addition, the Russian River tule/perch is considered by some to be a rare subspecies. It is restricted entirely to the Russian River and its tributaries. Otherwise, no rare or endangered plant species were identified.

The canopy of riparian trees is instrumental in providing for a healthy instream fauna in that the trees shade the water and keep it cool, provide protection for the fish from avian predators, and provide insect food and leaf litter that enhance the stream's productivity.

Because it has been systematically destroyed to only a fraction of its original extent, and because of its inherent biological value just described, the riparian habitat as a whole can be considered as an endangered community. Two principal conclusions follow directly from the fact that riparian habitat is valuable and endangered:

- (1) The remaining riparian habitats, espe-

cially well-developed forests, should be preserved.

- (2) Policies should be established that will lead to the gradual restoration of these forests.

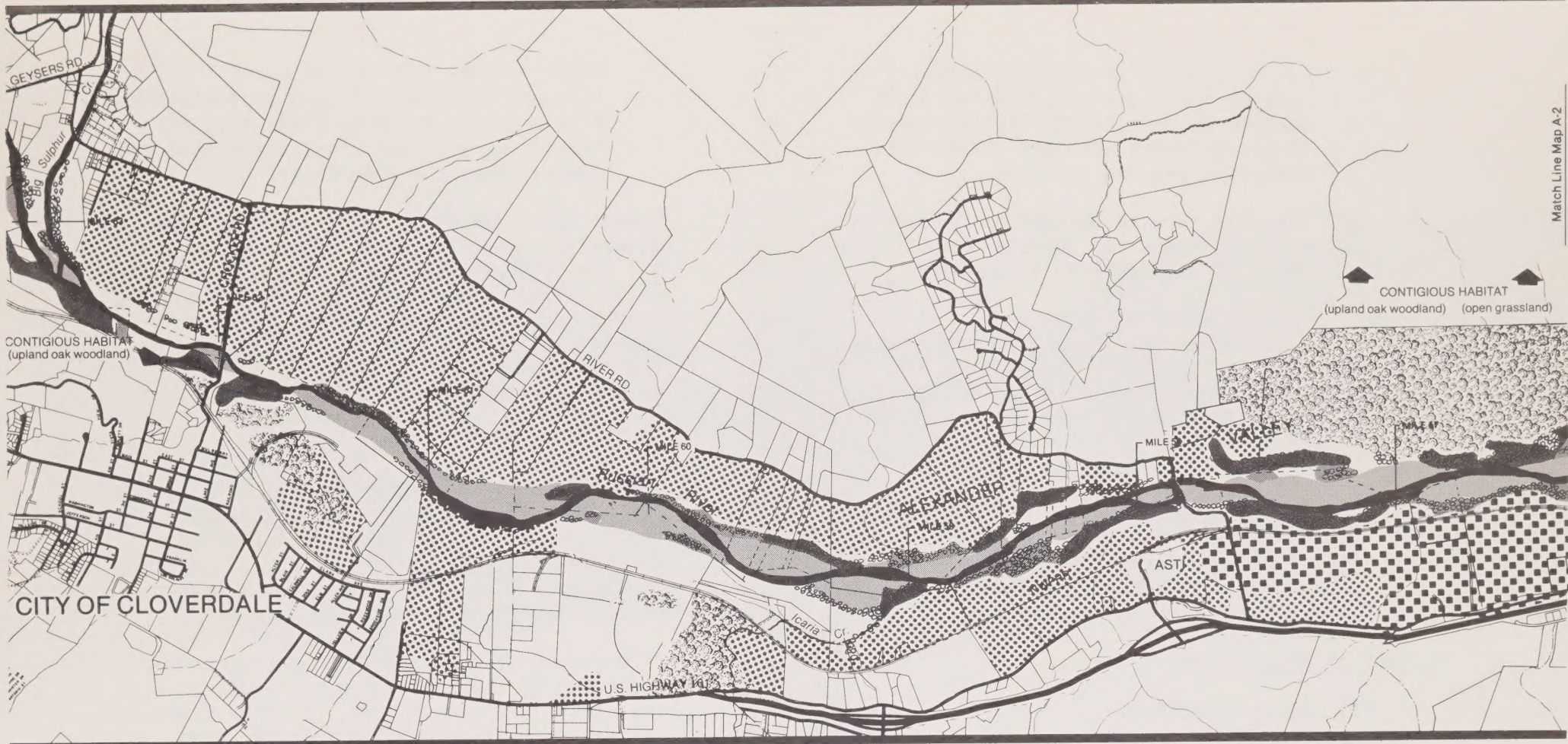
Classification of riparian habitats -

Mapped units: Four categories have been used:

- (1) The streams themselves.
- (2) Open habitats in which there is no continuous cover of shrubs or trees.
- (3) Developing riparian forest in which young trees, shrubs, and other plants are present and which would develop into mature forests given time.
- (4) Mature riparian forests.

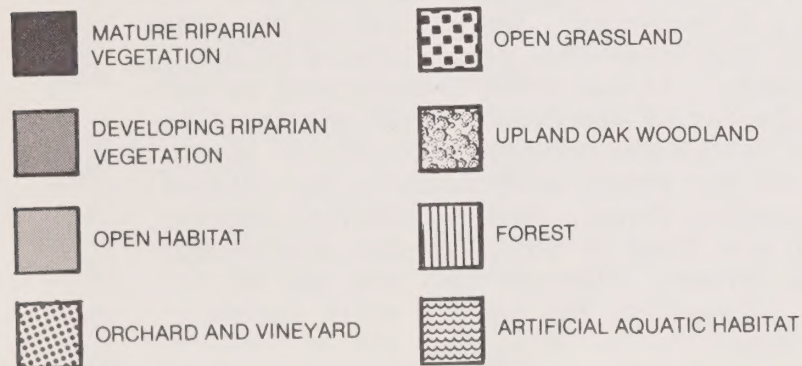
Other biotic features are indicated by numbers in the accompanying map key, and are described below. Each of the above map units contains one or more plant communities that can be identified in the field, although there is actually considerable overlap among them. The following outline lists these biotic communities, and each is then described more fully. A complete list of species is located in Appendix F.

- (1) Aquatic habitats (mapped as stream channel) include the main stem of the Russian River and tributaries of the river. "Artificial" aquatic habitats are also included along with other hydric communities such as overflow basins, intermittent drainage swales, freshwater marshes and vernal pools.



Match Line Map A-2

CONTIGIOUS HABITAT
(upland oak woodland) (open grassland)



FOREST TYPES

CB CAREX BEDS
DPC DUTCHMANS PIPE CONCENTRATION
BS BASKET SEDGE
CLO COAST LIVE OAK ASSOCIATION
VO VALLEY OAK ASSOCIATION
R/R REDWOOD / RIPARIAN ASSOCIATION
YWC YELLOW WILLOW CLIMAX FOREST

Russian River, Alexander Valley Cloverdale Section Map A-1

VEGETATION

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Scale 0 3000 6000 Feet
 0 900 1800 Meters

(2) Gravel bars or transitional communities between the river and forested lands (mapped as developing riparian vegetation) including sandbars, stabilized hummocks, and low terraces.

(3) Riparian forests (mapped as developing or mature riparian forests depending on stage of development) including:

Yellow Willow Thickets
Box Elder/Black Walnut/Cottonwood Association
Willow/Cottonwood Association
Cottonwood/Black Walnut/Valley Oak Association (Ethnobotanical Association containing Carex beds)

(4) Adjoining woodlands:

Redwood forest
Valley Oak Woodland/Savanna
Coast Live Oak Woodland

Habitat Description -

(1) Aquatic Habitats:

The main stem of the Russian River consists of a series of pools and riffles. Pools are dominated by two-year-old or more suckers, squawfishes, and hardhead. Large carp, green sunfish, bluegills, and largemouth and smallmouth bass may also be present, but in reduced numbers. Riffles are potential habitat for trout, but at present, willows that would normally shade and cool these areas are periodically being removed during channel maintenance activities. As a result, the habitat value of the riffle areas in the river is reduced. Butler and Hawthorne (1968) demonstrated experimentally that

cover becomes more essential as trout increase in size. It also protects the fish from predation by birds such as herons, egrets, and kingfishers that are common along the open water.

Summer water temperatures in the main stem generally exceed the 68°F value that is maximal for trout and salmon habitat (Winzler and Kelly, 1978). The stream at R.M. #66 and #70 (north of Sonoma County border) is the only significant exception to this. In addition, the ratio of pools to riffles is 4.8:1, much higher than the 1:1 ratio characteristic of good salmon and trout nursery habitat (Winzler and Kelly, 1978).

Spawning conditions were given by Winzler and Kelly as optimal from R.M. #30-62, however field sampling of sediments indicated that the gravels of the bed are packed at shallow depths with fine-grained sediments, thereby precluding effective spawning.

Tributaries of the river can be categorized according to their position with respect to the entire drainage system. Primary tributaries are those that flow into the main stem; secondary tributaries enter primary ones; and tertiary tributaries feed into secondary tributaries. The portion of Dry Creek within the study area constitutes a primary tributary. It and other intermittent primary tributaries of the Middle Reach and the Alexander Valley are marginal habitat for salmonids (salmon and trout) with annually and seasonally fluctuating flows. Most of the fish species which are found in the main stem also occupy these streams, although they are smaller in size. Squawfish and suckers still dominate the fauna.

Secondary tributaries are usually permanent

Match Line Map A-1



MATURE RIPARIAN
VEGETATION



OPEN GRASSLAND



DEVELOPING RIPARIAN
VEGETATION



UPLAND OAK WOODLAND



OPEN HABITAT



FOREST



ORCHARD AND VINEYARD



ARTIFICIAL AQUATIC HABITAT

FOREST TYPES

CB CAREX BEDS

DPC DUTCHMANS PIPE CONCENTRATION

BS BASKET SEDGE

CLO COAST LIVE OAK ASSOCIATION

VO VALLEY OAK ASSOCIATION

R/R REDWOOD/RIPARIAN ASSOCIATION

YWC YELLOW WILLOW CLIMAX FOREST

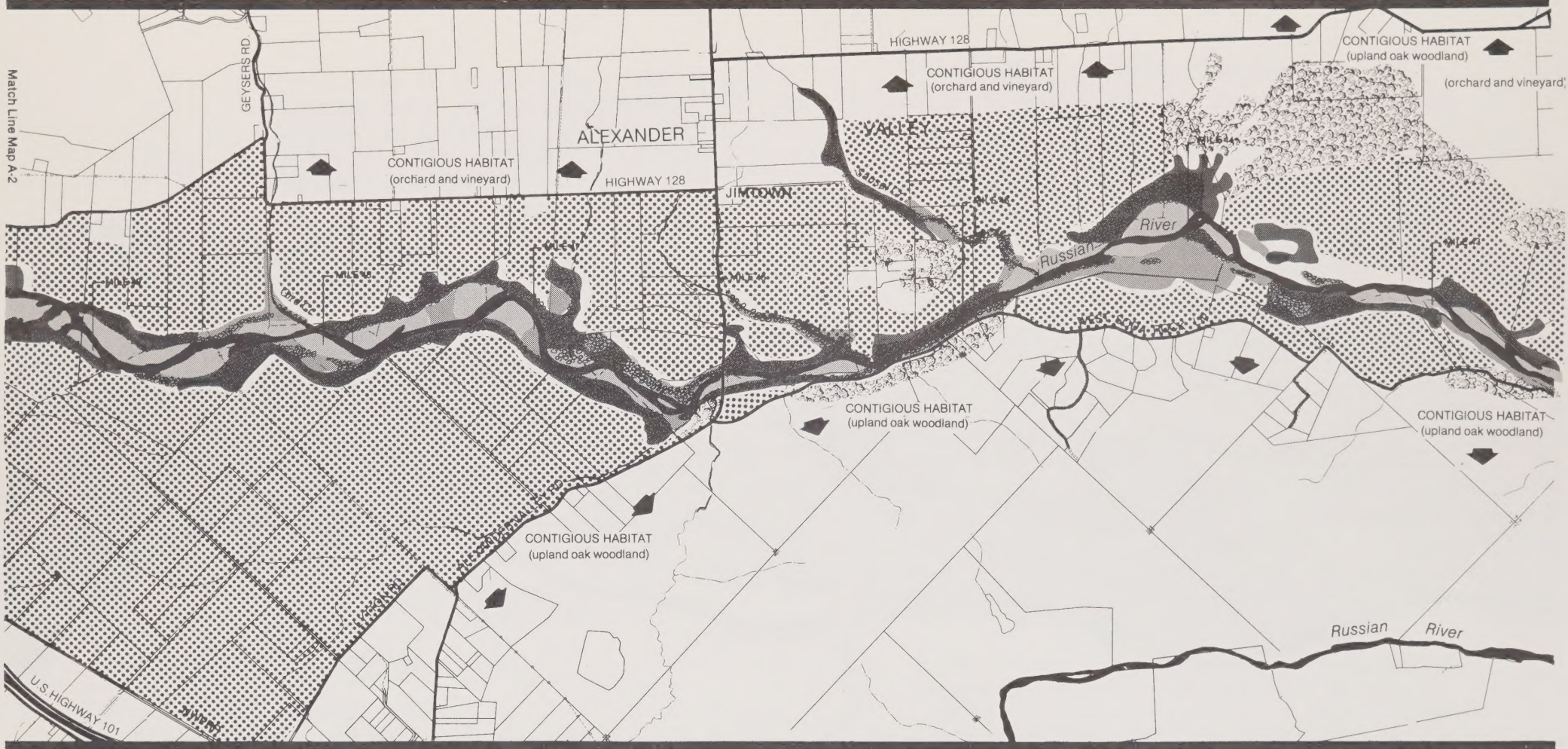
Russian River, Alexander Valley Geyserville Section Map A-2

VEGETATION

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Scale 0 3000 6000 Feet
0 900 1800 Meters



Russian River, Alexander Valley Jimtown Section Map A-3

VEGETATION

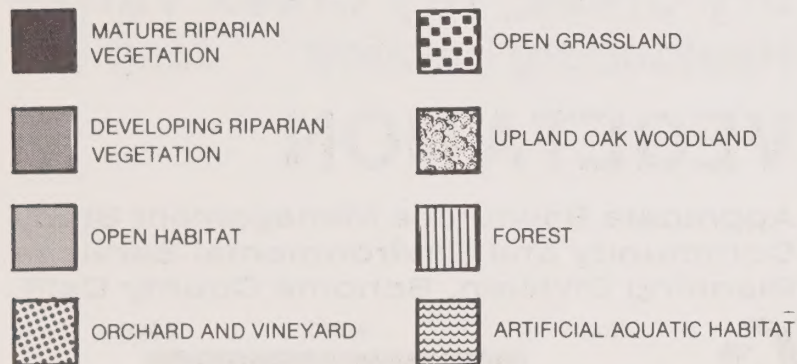
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Scale 0 3000 6000 Feet
0 900 1800 Meters



Match Line Map B-2



FOREST TYPES

CB CAREX BEDS

DPC DUTCHMANS PIPE CONCENTRATION

BS BASKET SEDGE

CLO COAST LIVE OAK ASSOCIATION

VO VALLEY OAK ASSOCIATION

R/R REDWOOD/RIPARIAN ASSOCIATION

YWC YELLOW WILLOW CLIMAX FOREST

Dry Creek, Dry Creek Valley Yoakum Bridge Section Map B-1

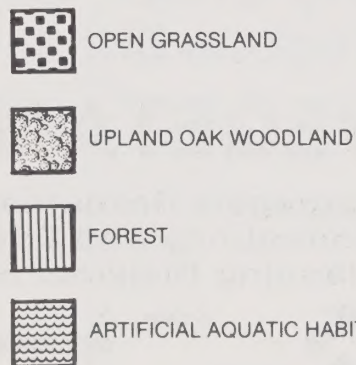
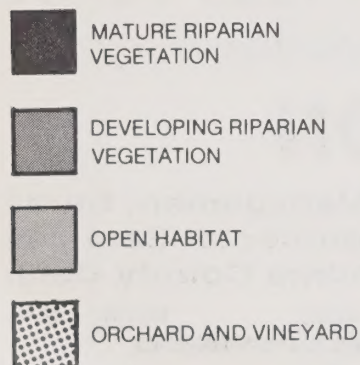
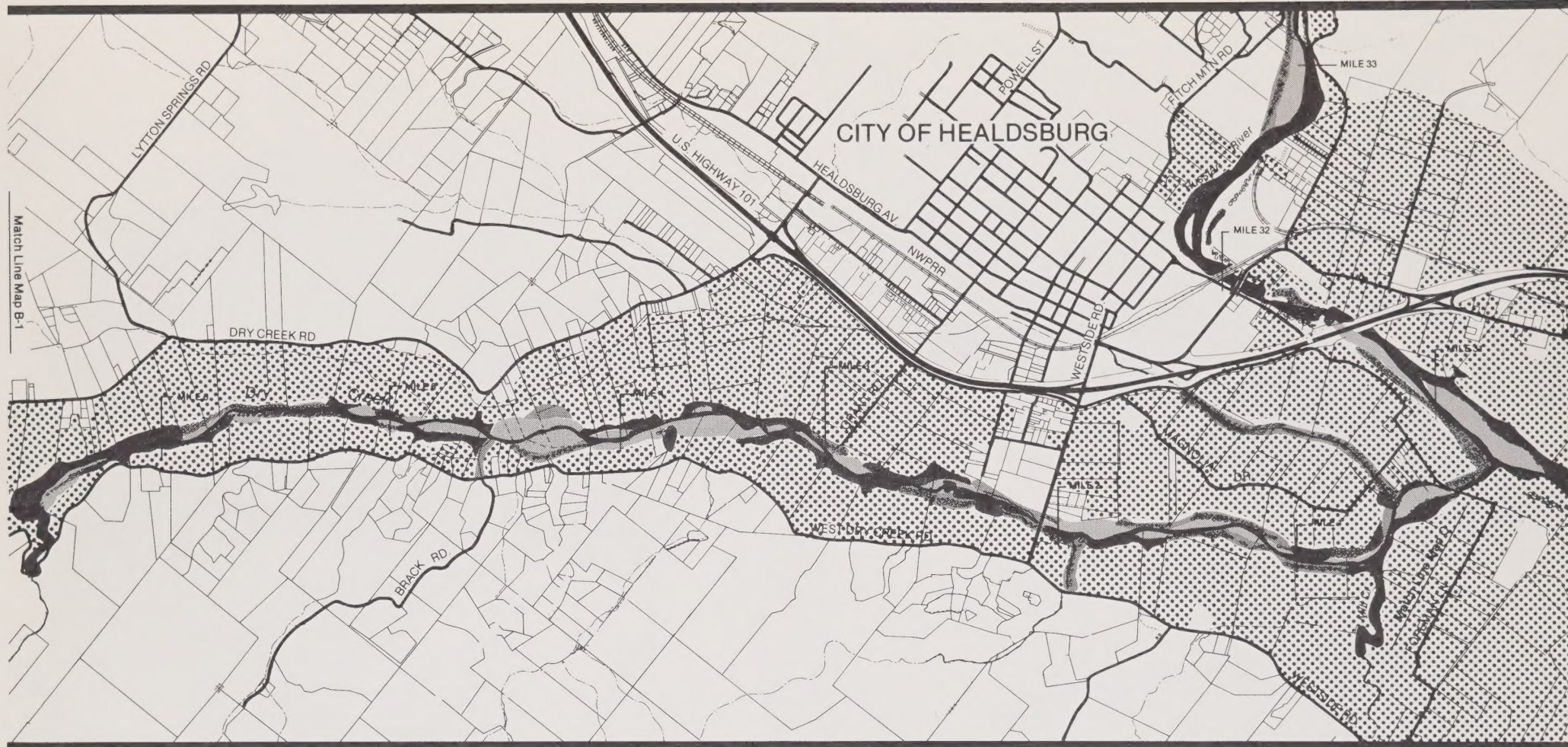
VEGETATION

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Scale 0 3000 6000 Feet

0 900 1800 Meters



FOREST TYPES

- CB** CAREX BEDS
- DPC** DUTCHMANS PIPE CONCENTRATION
- BS** BASKET SEDGE
- CLO** COAST LIVE OAK ASSOCIATION
- VO** VALLEY OAK ASSOCIATION
- R/R** REDWOOD/RIPARIAN ASSOCIATION
- YWC** YELLOW WILLOW CLIMAX FOREST

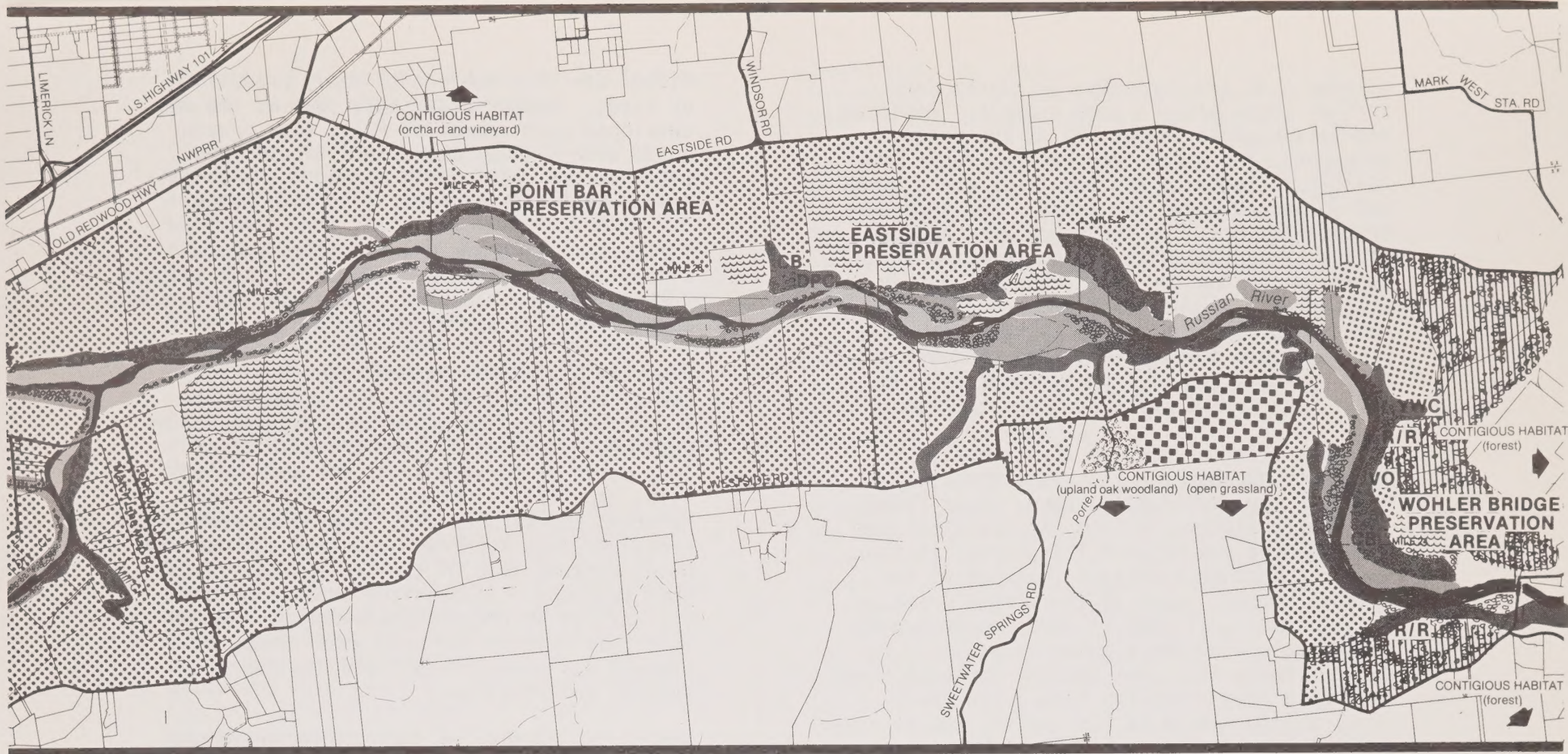
Dry Creek, Dry Creek Valley Healdsburg Section Map B-2

VEGETATION

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Scale 0 3000 6000 Feet
0 900 1800 Meters



**MATURE RIPARIAN
VEGETATION**

**DEVELOPING RIPARIAN
VEGETATION**

OPEN HABITAT

ORCHARD AND VINEYARD

OPEN GRASSLAND

UPLAND OAK WOODLAND

FOREST

ARTIFICIAL AQUATIC HABITAT

FOREST TYPES

CB CAREX BEDS

DPC DUTCHMANS PIPE CONCENTRATION

BS BASKET SEDGE

CLO COAST LIVE OAK ASSOCIATION

VO VALLEY OAK ASSOCIATION

R/R REDWOOD/RIPARIAN ASSOCIATION

YWC YELLOW WILLOW CLIMAX FOREST

Russian River, Middle Reach Map C

VEGETATION

**Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.**



Scale 0 3000 6000 **Feet**
0 900 1800 **Meters**

streams that are dominated by roach; Warm Springs Creek being a good example. Riparian vegetation often shades 50% of the wetted streambed, and water temperatures range from 70-75°F in summer. Rainbow trout are present but do not dominate the fauna. Few secondary tributaries occur in the study zone because of its linear definition. No tertiary tributaries occur for the same reason, but they will briefly be described because of their relationship to the entire system. They are usually cool, completely shaded, and are primary spawning grounds for resident rainbow trout, the fry of which dominate the fauna.

The most critical part of any tributary is its mouth because the fish pass through it on their way upstream to spawn. Even fishes that don't migrate in from the sea still may move through one or more tributaries in the system. Another important function of the tributary mouth, even if the stream dries up in the summer, is that it forms an embayment on the main stem where water velocity is reduced. Young fish seek shelter in these areas from main stem predatory fish. The roach, a small minnow native to the system, was recorded by Pintler and Johnson (1957) as being common in the main stem only around the mouths of tributaries, and the tuleperch, a native live-bearing species, enters the mouths of tributaries to deliver its young.

Artificial aquatic habitats occur both within and outside of the channel. They include summer swimming ponds and terrace gravel pits. Summer recreational ponds such as that behind Healdsburg Dam create passage problems for shad, king salmon, and steelhead during their spawning migration (Vestal and Lassen, 1969). Areas where ponds are created by instream dredging, such as that at the mouth of Dry Creek, accumulate silt and lack plant cover.

Fishes are thus subject to heavy predation by birds. Summer crossings, such as the one developed each summer at Asti, also create ponds with similar characteristics. They often become choked with algae, and are similar to side-channel ponds described below.

The terrace pits are usually silty on the sides, and inhabited by warm water fish species such as catfish, suckers, squawfish, smallmouth bass, bluegill, and green sunfish.

Overflow basins and intermittent drainage swales are formed as the river changes its course. During low water periods, the drainages are disconnected from the main river. They serve as nursery areas for warm water fish, especially suckers, squawfish, roach, hardhead and sticklebacks. They also serve as breeding areas for frogs and toads, whose tadpoles consume some of the dense algal growth that develops. In previous eras, side ponds (as well as in-channel ponds) could develop into deep refuges for cold water fish, but present day ponds are all shallow due to channel modifications.

Around the margins of these ponds are found saplings of trees, cattails, and various sedges and rushes. Several grass species characteristic of wet places are also found, such as bentgrass, beard grass, and velvet grass. Herbaceous plants are also present, particularly Draba verna, or whitlow-"grass". The water often has watercress spreading over its surface and submerged flowering plants and algae in the water itself.

These ponds are utilized heavily as feeding grounds for vertebrates, including the western aquatic garter snake, the great blue heron, migratory ducks, and raccoons. They also abound with the aquatic larvae of terrestrial

insects. Fish eat the larvae and birds feed on the insects when they emerge.

Freshwater marshes may develop in shallow basins on terraces above the stream, which will see more extensive development of cattails or bulrushes than the above habitat. When the expanse of these plants becomes large enough, red-winged blackbirds will utilize them as nesting sites. At that point, the community becomes a freshwater marsh rather than a basin or swale habitat. None of these marshes was noted in the study area, probably due to the confinement of the channel and to land use practices on the flood plain that prevent old drainage basins from being formed and naturally vegetated.

Vernal pools occur when low depressions are formed by meander scars among scattered oaks on the floodplains. They dry up in late spring. Such areas support a distinctive vegetation of annual plants that are adapted to such conditions, including aquatic buttercups, beethistle, meadowfoam and others, some of which are rare species. The aquatic phase of the pool is rich in insect life and is an important breeding site for the Pacific tree frog. Only one such pool was located during this study, near the intersection of Windsor River Road and Eastside Road along the entrance to Kaiser's north pit. Its deeper waters contained an incipient freshwater marsh. Both were destroyed by discing and planting of the land in the spring of 1978.

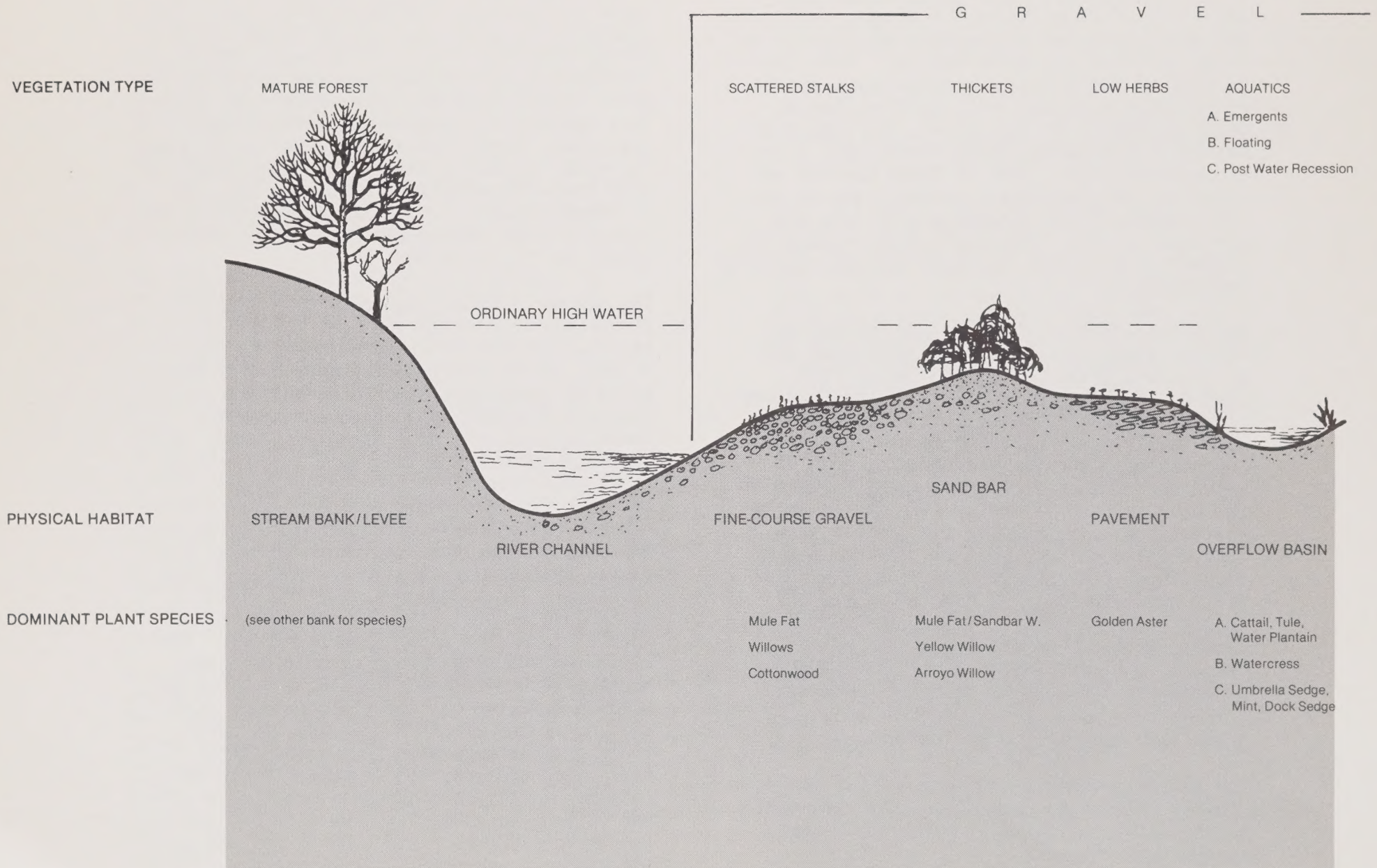
Gravel Bar Habitats: (See drawing.)

The several habitats of the gravel bar are so closely related to each other that they will be discussed collectively here rather than as separate entities.

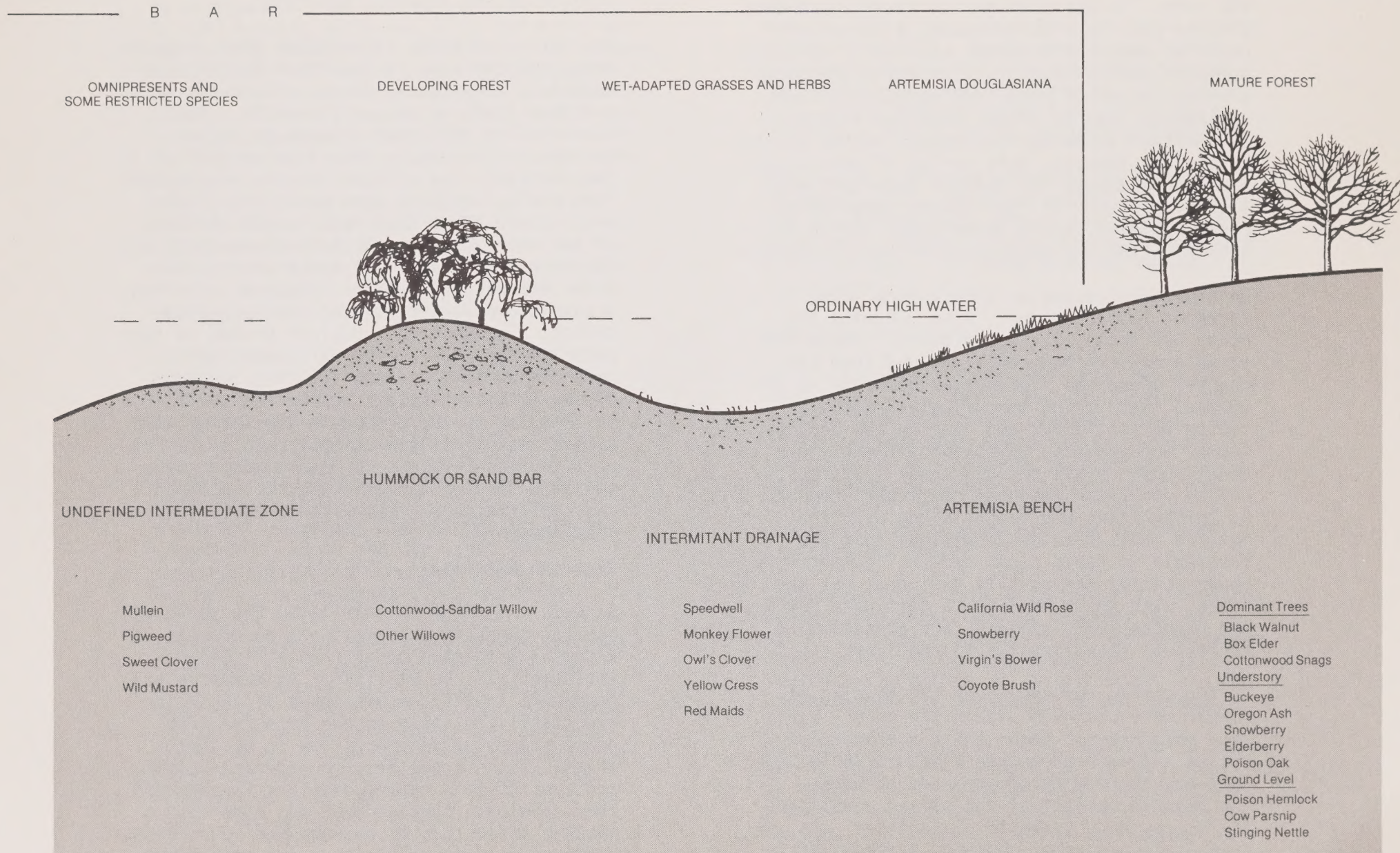
Gravel bars are components of the riverine environment that accumulate coarse grained material on the concave side of the thalweg. As a physical unit they are highly variable in terms of substrate and local topography. The prominent features can include: open floodplain, ephemeral ripples and dunes, stabilized sand bars and hummocks, low terraces, and a series of accompanying hydric or marsh-like communities composed of intermittent drainages, swales and overflow basins of varying water retaining capacities. The vegetation that characterizes such areas responds to these physical constituents, developing with and often influencing the future processes of bar formation.

The stages in which the vegetation develops frequently begin with the open floodplain, the low-relief area lying adjacent to the river. The soil here is predominantly composed of cobblestones, pebbles and gravel. Frequent flooding and consequent scouring leave this habitat considerably open and only sparsely covered with vegetation. The principal colonizers here are typically willows and mule fat, Baccharis viminea. They are usually represented by scattered woody stalks. However, due to their rapid growth rates and sucker producing capabilities, they can also form dense linear patches. During floods, these patches or belts of vegetation act as natural traps for water-borne sediments, facilitating the development of sand bars and thereby expanding the colonizer's habitat as well as allowing for the emergence and eventual dominance of other species. As more finer-grained particles settle out during slack current flows, these newly formed habitats are usually dominated by sand-bar willow and cottonwood. However, areas of high water retaining capacity often support red and yellow willows, with the latter being the more common.

GRAVEL BAR



CROSS SECTION



As the cottonwoods and willows become firmly established, they eventually form thickets, furthering the growth and stabilization of the bars. In areas along the river where this process continues undisturbed, a series of parallel sand-bar thickets and nearly forested hummocks can be found, all of which represent varying stages of gravel-bar succession that ultimately lead to climax riparian forests. In addition to being forerunners to the mature bottomland forests, this series of developing bars and hummocks has another important ecological effect: it facilitates oxbowing or river braiding, which contributes to the diversification and complexity of the floodplain.

On broad and expansive gravel bars, young terraces or raised benches often mix with the other bed forms that are present. These elevated areas are generally removed from the channel where the flood-water velocity is decreased, permitting more finely-grained particles to settle out and overlay the cobblestones and gravels. Although extremely dry conditions prevail on such sandy flats most of the year, the temporary moisture brought by spring rains and floods along with the fertile soils provide conditions that are favorable to rapid plant growth. Competitive woody species are usually excluded, but annuals, with their ability to germinate, grow, and produce seeds rapidly, are abundant and contribute significantly to the flora.

During spring surveys, over 150 species of plants were observed within the gravel bars. Many more had not begun their reproductive cycles and were therefore unidentifiable. Bars may be considered ecotones between the aquatic habitat of the stream itself and the surrounding terrestrial habitats. As such, this ecosystem contains elements of both the aquatic and terrestrial ecosystems

plus retaining unique characteristics not found in these two ecosystems. Not surprisingly, such areas are the most floristically diverse of the riparian habitats.

The series of plant communities that occupies the gravel bar zone is important habitat for animals. Many frogs, toads, and snakes breed and feed there as do small mammals. The black-tailed mule deer browses on herbs, grasses and shrubs in this zone as well as in the forests. The killdeer breeds on the open floodplain, which is used heavily by other small shore birds that feed in the shallows of the river. Dense thickets on sandbars are the breeding habitat for the mourning dove, acorn woodpecker, western kingbird, starling, orange-crowned warbler, and common yellowthroat. The spotted sandpiper breeds at the water's edge under covering vegetation. Many other birds use the area for feeding, either in flight (black phoebe and swallows), or foraging on the ground or vegetation with a wide variety of habits that enable them to utilize flowers, insects, and seeds. Hawks and owls feed on larger insects, reptiles and small mammals. Mammalian predators are also present.

Riparian Forests:

As with the gravel bar habitats, the various habitat types in this unit are so closely integrated with each other that a single description will be utilized. As hummocks and sand bars in the concave bends of the river are stabilized, they become forested with dense stands of yellow willow in moister areas. These trees grow to moderate height, and constitute a rather distinct forest type. They develop a subcanopy of box elder and a shrubby understory of dogwood and spice bush. Vines of wild grape trail up the tree trunks into the canopy where light is available.

Other developing hummocks are stabilized by sandbar willow, which eventually is overtopped by cottonwood. The cottonwood grows rapidly to full height, while box elder and black walnut develop beneath it. Eventually the cottonwoods begin to die back, providing abundant habitat for woodpeckers and other hole-nesting species. A mature forest of black walnut and box elder develops. On young, drier terraces where there is insufficient moisture for willows and cottonwoods, the box elder/black walnut association may develop following a shrubby stage. The riparian forest gives way to oak woodland or savanna away from the riparian zone. Along the immediate bank of the river, especially where it is cutting, white alders, willows and cottonwoods grow.

These forests are characterized by having several layers of vegetation below the overstory. A subcanopy of smaller trees exists, and often includes California bay-laurel, buckeye, and Oregon ash in addition to the species listed above. Beneath this is a shrubby understory which in mature forests includes snowberry, blackberry, poison oak, ninebark, spicebush, elderberry, Artemisia, honeysuckle, rose, and the giant reed, a vigorous introduced weed that seems to be increasing in abundance along the river.

A fourth layer of herbaceous plants is found at ground level, dominated by poison hemlock, cow parsnip, and stinging nettle. In some of the forests, Indians have cultivated the basket sedge, Carex barbarae, in large tracts to the exclusion of other ground cover. This plant is and was used in making fine baskets. Several species of vines are also found, including wild grape, poison oak, dutchman's pipe, Virginia bower, and wild cucumber.

The layering of vegetation in these forests, together with their proximity to a source of food in the river and their prolific deciduous growth, makes them ideal habitat for a diverse array of animals. Large insect populations occur in summer, and soil organisms feed on the leaf drop in fall and winter. The ring-tail cat is thought to be present in these forests as are a variety of smaller mammals.

Birds with a primary affinity for riparian forests include the green heron, wood duck, red-shouldered hawk, downy woodpecker, Swainson's thrush, yellow warbler, and yellow-breasted chat. All were observed in the study area.

Adjoining Woodlands:

Near the Wohler Bridge are a few stands of redwood forest. This community is much less diverse than bottomland riparian forest, as it is more densely shaded and is strongly dominated by the redwoods themselves. Redwoods become much more prevalent from this point toward the coast as the river enters the canyons where much more fog and cooler temperatures prevail.

Within the study area there are still sections where valley oaks, and to a lesser degree coast live oaks, are found in contiguous woodlands or savannas. The understory of these regions is primarily at ground level, and consists largely of introduced annual grasses.

Ecological Succession: The relationship among the various plant communities can be summarized in the following diagram, which represents in a general way how they are related to one another in time and to the changes wrought in the physical environment by the hydrologic processes of the river. The physical locations

RESILIENT COMMUNITIES

Stages redevelop quickly if perturbed, provided similar physical settings are established.

FOREST ASSOCIATIONS

Do not redevelop until earlier stages have occurred.

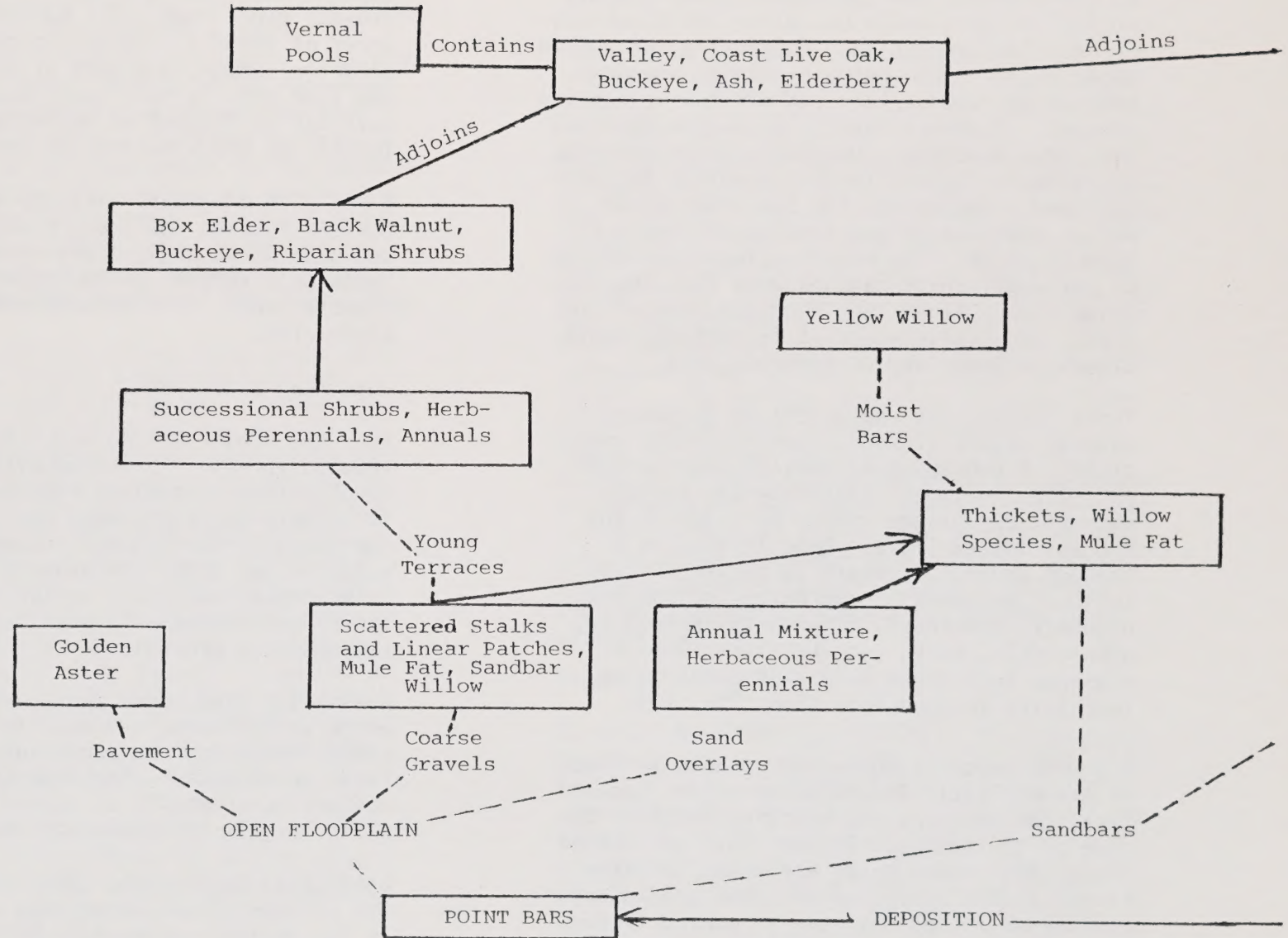
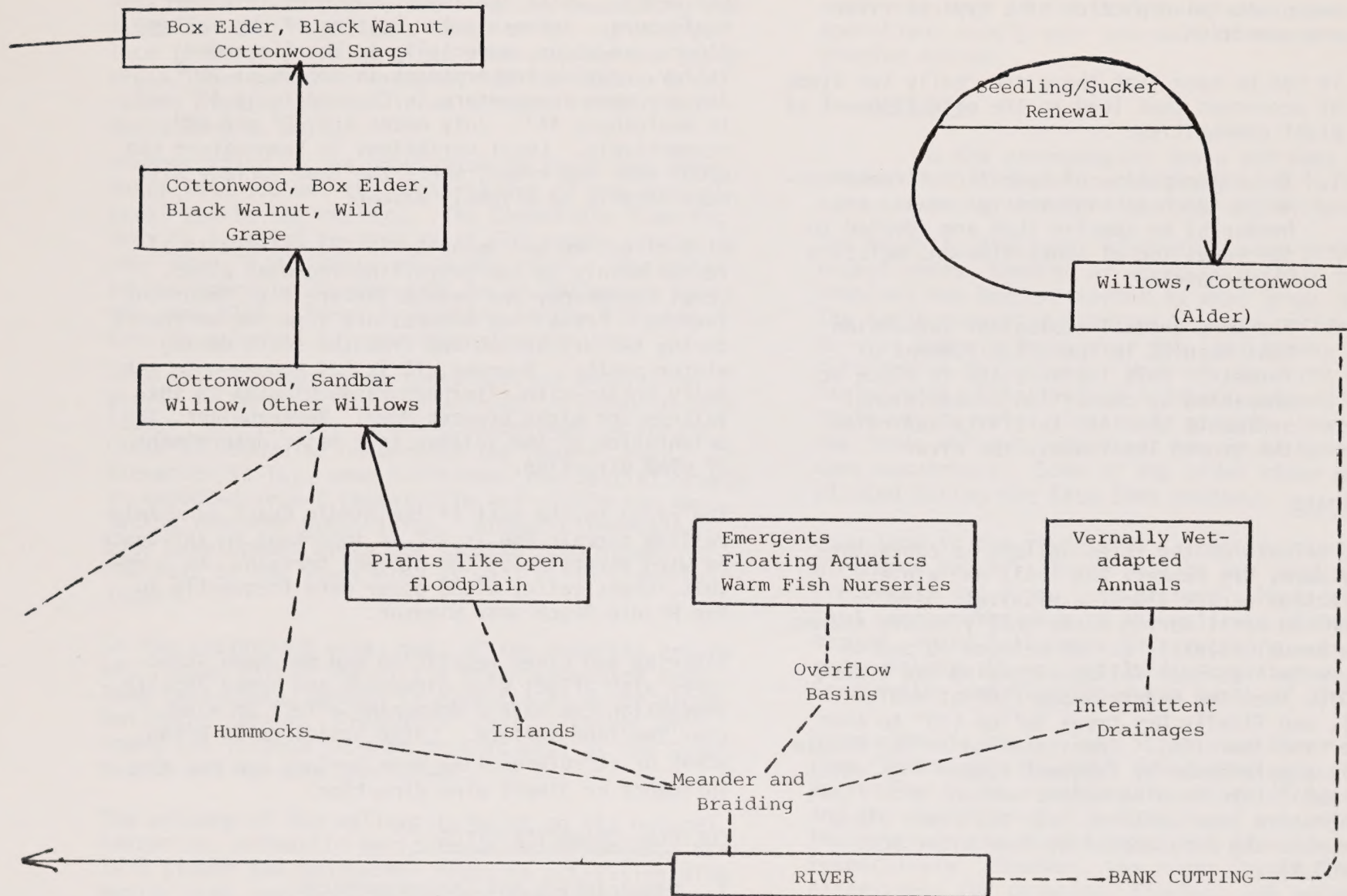
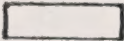
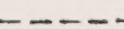


DIAGRAM OF SUCCESSIONAL RELATIONSHIPS



 Communities
 Succession
 Physical Processes and Landforms

of the communities are shown in the accompanying pictorial depiction of a typical river cross-section.

It can be seen that there are really two kinds of processes that lead to the establishment of plant communities:

1. The colonization of specific microenvironments (such as sandbars, pavement, and hummocks) by species that are adopted to the condition of substratum and moisture they contain.
2. The more gradual ecological succession that results in the establishment of forests. This latter stage is often accompanied by deposition of additional sediments that add fertility and raise the ground level above the river.

5. Climate

The climate of the three valleys is characterized by warm, dry summers and cool, wet winters. Precipitation occurs almost exclusively between November and April during occasionally severe storms. Average annual rainfall varies between 35 and 45 inches, with Alexander Valley averaging the lowest (35"-40"), then the Middle Reach (40" at Wohler Bridge), and finally Dry Creek Valley (35" to over 40" near the dam site). Precipitation in the Middle Reach is supplemented by frequent summer fogs which remain until late morning before burning off. This "fog intrusion zone" extends from the coast along the river to the area around Windsor River Road (R.M. #28.4).

Average annual temperatures in the three valleys range from 58⁰ to 60⁰ with the cooler average occurring at the southernmost locations. Seasonal extremes do occur, however, but extended periods below freezing are rare. The highest observed tem-

perature in the study area has been 119⁰F near Cloverdale, while the lowest has been 18⁰F near Healdsburg. Intense solar heating of the valley floors can occur, especially in the Alexander Valley, causing temperatures in excess of 100⁰. January mean temperature in Cloverdale is 47⁰ and in Healdsburg 44⁰. July means are 72⁰ and 69⁰, respectively. Local variations in temperature can occur near the river, where the land surface will occasionally be slightly warmer.

Wind direction and velocity in the valleys is affected mainly by the prevailing regional winds. Local topography and vegetation are also important factors. Prevailing breezes are from the northwest during the dry season and from the south during winter months. However, it is not uncommon to get daily shifts with afternoon winds blowing up the valleys and night breezes down. Nevertheless, the orientation of the valleys is a major determinant of wind direction.

The ridge to the east of the Middle Reach is mainly rolling terrain and is not as important an influence on wind direction as the steeper terrain. As a result, cross valley winds occur more frequently in the Middle Reach near Windsor.

Riparian and other vegetation and man-made structures also affect wind direction and speed locally. Vegetation can have a dampening affect on winds near the land surface. Large buildings in urban areas or structures like Warm Springs Dam can also influence or divert wind direction.

CULTURAL CHARACTERISTICS

1. Demographics and Socioeconomics

The Alexander Valley falls within the Cloverdale Planning Area, the Middle Reach in the Healdsburg Planning Area, and Dry Creek Valley split between the two. 1975 population for the

Cloverdale area was slightly less than 8,000 people, with 58% living in urban Cloverdale and Geyserville. Population in the Healdsburg Planning Area in 1975 was over 6,000 in urban Healdsburg and 4,900 in rural locations. Much of the rural population in these planning areas lives outside the study areas, however. For example, the Healdsburg area covers Windsor and the lands between Windsor and Healdsburg as well.

Accommodation of the population in these two areas takes into account the preservation of the agricultural use in the valleys. The Cloverdale Planning Area is expected to grow to 12,000 people by the year 2000; 8,000 urban and 4,000 rural. The City of Healdsburg will grow 135% to 14,500 people by the same time. Rural population in the Planning Area is expected to grow approximately 39%.

Very little, though, of the projected population growth is forecast for the valleys included in this study. Development is being encouraged to locate close to community centers by the General Plan. In Alexander Valley, some additional residential growth is expected around Geyserville and within the existing Vineyard Subdivision. Around Cloverdale, some development areas are located immediately to the east of the study area as well as in Cloverdale itself.

In the Healdsburg area, most of the expected growth will occur within the city's urban expansion area. Some residential growth is expected to occur along Bailhache Avenue. Presently, small clusters of homes are located in that area as well as the Grant Avenue and Foreman Lane areas.

The economy of the valleys is based on its natural resources, primarily agriculture and minerals. Upland timber and geothermal resource activities also employ area residents and affect the local economy. The major mineral resource is sand and gravel extracted from the river and its flood plain terraces. Mining operations in the Alexander Valley do not

employ as many people as in other areas because much of the processing is accomplished elsewhere in the County. However, many of the County's mining employees work in the Healdsburg area where terrace operations supply over one-half of the present aggregate demand.

2. Land Use

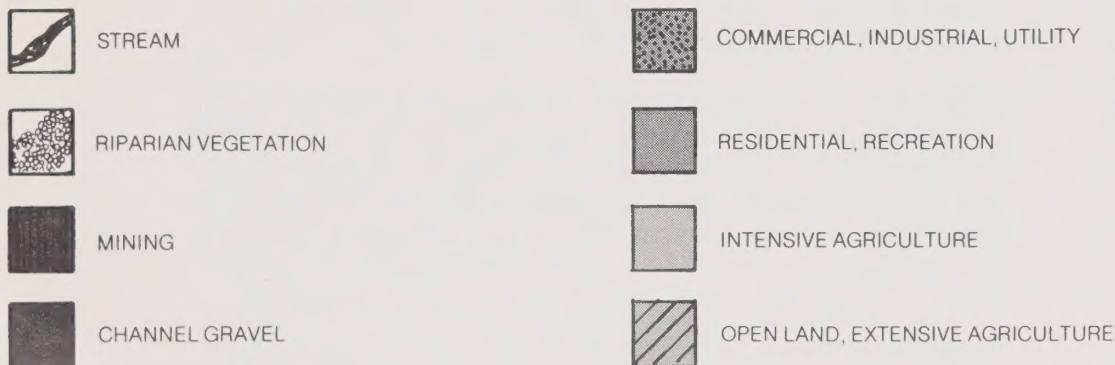
As the accompanying table and maps show, the predominant land use in the study area is intensive agriculture, primarily vineyards and orchards.

The major agricultural product is wine grapes. In recent years, hundred of acres of orchard and other cropland has been converted to wine grape production. The table comparing Countywide prune orchard acreage to wine grape acreage over the last twenty years illustrates this trend. Many of the acres listed on Table IIC-6 as "fallow" or "recently plowed" are on their way to being planted in grapes. However, in the three valleys, vineyards are by no means a recent occurrence. Some of the older vines were planted during the late 19th century.

Open land in the study area is mainly found in the Alexander Valley. These uplands are used most frequently for range and pasture. Most of the land surrounding each of the valleys, although not mapped, would fall under this category. In Alexander Valley, these open lands occur between Geyserville and Cloverdale and south of Jintown.

Recreation in the valleys is Russian River-oriented. (See "Hydrologic History" for further discussion of recreation in Russian River.) Memorial Beach Park and the Alexander Valley Campground are adjacent to the river in the Middle Reach and Alexander Valley, respectively. However, the river itself is used extensively for canoeing, fishing, and swimming.

"Unofficial" access to the river is available at bridges and crossings throughout the Alexander and Middle Reach Valleys. No access is presently avail-



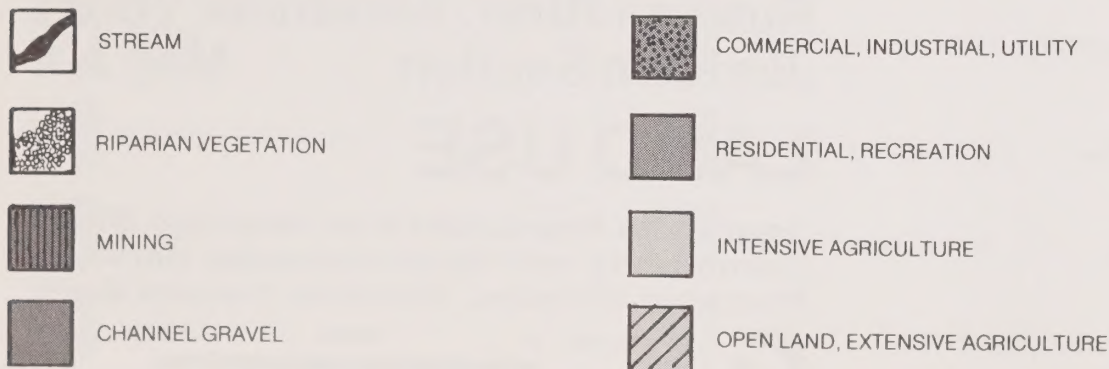
Russian River, Alexander Valley Cloverdale Section Map A-1

LAND USE

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
0 900 1800 Meters



Russian River, Alexander Valley Geyserville Section Map A-2

LAND USE

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
0 900 1800 Meters



STREAM



RIPARIAN VEGETATION



MINING



CHANNEL GRAVEL



COMMERCIAL, INDUSTRIAL, UTILITY



RESIDENTIAL, RECREATION



INTENSIVE AGRICULTURE



OPEN LAND, EXTENSIVE AGRICULTURE

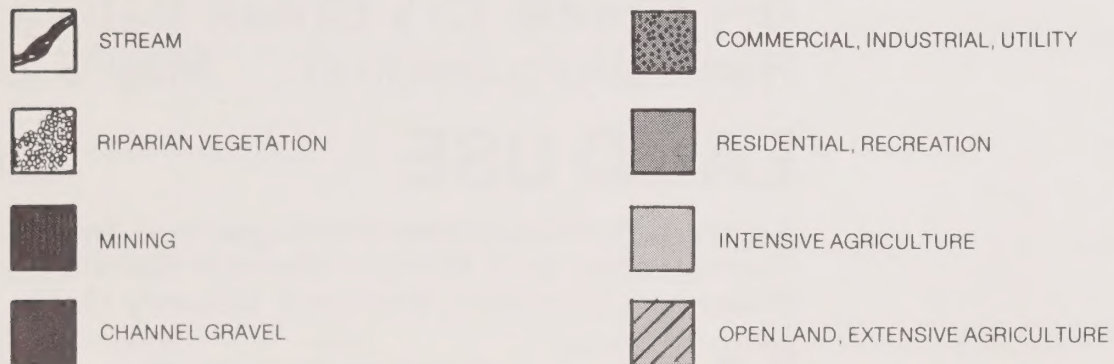
Russian River, Alexander Valley Jimtown Section Map A-3

LAND USE

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
0 900 1800 Meters



Dry Creek, Dry Creek Valley Yoakum Bridge Section Map B-1

LAND USE

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
0 900 1800 Meters

TABLE II. C-6

LAND USE ACREAGE				
Use	Alexander Valley	Dry Creek	Middle Reach	Total
1. Agriculture				
a. Vineyard	5,230	2,497	2,300	10,027
b. Orchard	1,035	1,227	1,098	3,360
c. Fallow	835	224	613	1,672
d. Recently Plowed	80	30	15	125
2. Open Land	1,970	71	201	2,242
3. Recreation	15	--	7	22
4. Residential	175	82	157	414
5. Commercial, Industrial, Utility	460	62	149	671
6. Stream Channel and Riparian	1,960	697	888	3,545
7. Mining	--	37	273	310
8. Forest	--	--	474	474
TOTAL ¹	11,760	4,927	6,175	22,862

¹Land Use acreages may differ somewhat from other acreage totals.

Source: Sonoma County Water Agency
Sonoma County Planning Division

able to Dry Creek. Recreation is also prevalent near Wohler Bridge, though it is not officially sanctioned. Estimates of the basin-wide recreational use were made in 1973 and included in the

TABLE II. C-7

Year	Bearing Acreage		Price Per Ton	
	Prune	Wine * Grape	Prune	Wine Grape
1960	13,918	10,705	\$377.61	\$ 90.00
1961	14,197	10,625	320.81	135.00
1962	14,711	10,600	238.00	96.10
1963	15,156	10,669	247.00	96.70
1964	15,743	10,770	263.86	136.67
1965	16,243	11,188	205.54	107.20
1966	15,807	11,572	318.23	102.49
1967	15,821	11,765	274.60	112.00
1968	16,146	12,764	272.71	132.97
1969	15,997	12,579	293.60	166.29
1970	15,284	12,597	250.00	255.70
1971	11,250	12,332	270.00	342.97
1972	10,406	12,689	322.00	455.12
1973	6,353	13,452	480.00	508.00
1974	6,254	13,798	440.00	272.02
1975	6,309	16,151	415.00	238.94
1976	6,299	19,474	347.00	339.80
1977	5,869	23,335	412.03	453.23
1978	5,344	24,087	493.08	473.43

* Wine grape plants require 3 to 5 years before they begin to bear.

Warm Springs Dam Environmental Impact Statement. 2,500,000 visitor-days per year included 25,000 to 50,000 annual use days for canoeing and river touring and 70,000 angler days per year for salmon and steelhead fishing.

Commercial, industrial, utility, and residential uses are centered mainly near Cloverdale, Geyserville, and Healdsburg. Exceptions are the Warm Springs Dam construction site near Bord Bridge in Dry Creek Valley, the Healdsburg sewage treatment facility near the mouth of Dry Creek, and various wineries located throughout the valleys. As previously mentioned, residential tracts are located in some rural areas, but most of the non-urban homes in the valleys are farms.

Commercial extraction and processing of sand and gravel is a major land use in all three valleys. In the Alexander Valley, a 1978 extraction of about 800,000 tons was divided among five companies at seven instream sites.

1. Cloverdale Ready-mix (R.M. #62.2)
pit and plant
2. Piombo Corporation
 - a. Cloverdale Airport (R.M. #59)
 - b. Geyserville pit and plant (R.M. #53.8)
3. Basalt Rock Company (R.M. #51.2-#52.8)
4. Paul Cavallo Trucking, Inc. (R.M. #47.4)
5. Harold Groom, Inc.
 - a. East Soda Rock Lane pit and plant
(R.M. #44.7)
 - b. Cadd/Drake property (R.M. #49.5)

Materials are processed at three of the above locations: Cloverdale Ready-mix, Piombo Geyserville, and Harold Groom Soda Rock Lane. Extraction is by the skimming method at all sites, and products are trucked to delivery points in Napa, Sonoma, and

Mendocino Counties.

In the Middle Reach and Dry Creek Valleys, both instream and terrace extraction occur. Nine operators are ongoing under five ownerships.

1. George Brown - instream (D.C.\$M. #9.4)
2. Soiland, Inc.
 - a. Instream pit and plant (D.C.R.M. #2)
 - b. MacMurray property - terrace (R.M. #23.5)
3. Basalt Rock Company
 - a. Plant (R.M. #32)
 - b. Healdsburg pit and instream (R.M. 29-30)
 - c. Doyle pit and plant (R.M. #26.4)
4. Quarry Products, Inc. - pit and plant (R.M. #27-8)
5. Kaiser Sand and Gravel
 - a. Terrace pit and plant (R.M. #25.1)
 - b. Terrace pit (R.M. #27.2)

Virtually all materials extracted in this area are also processed locally before being hauled to regional markets. Both instream and terrace operations are present.

3. Circulation

The primary access route to and from Alexander Valley is U. S. Highway 101, which runs essentially parallel to and along the west side of the valley. Other access routes include State Highway 128 connecting Geyserville to Napa County east of the river through southern Alexander Valley, and Alexander Valley Road connecting Healdsburg and

Highway 128 at Jintown. Trucks use these routes to transport instream gravels to markets. (See map of existing haul routes in Section IV.) At present, most of the gravels mined in Alexander Valley are delivered for use outside of the valley.

Intermediate routes are used to haul aggregate products from the extraction areas to the primary access routes. Cloverdale Ready Mix trucks use the east bank levee to Crocker Road Bridge. The Piombo Corporation airport operation hauls rock directly from the bar to the airport site along a dirt road. The Geyserville operation trucks drive between vineyards and along River Road to Highway 128 and Geyserville. Basalt's Geyserville site is accessible directly from Highway 128 at the bridge. The access to Harold Groom, Inc.'s Cadd/Drake site is via the agricultural land east of the river to Highway 128. The East Soda Rock Lane site can be reached from Highway 128 and East Soda Rock Lane. Cavallo Trucking, Inc. also has a dirt road through farmland for access to Highway 128.

Dry Creek and Middle Reach

U. S. Highway 101 provides regional access to the Healdsburg area from north and south. Each of the valleys is accessible from Healdsburg by rural roads which parallel and form the outer edge of the valley floors. Rail access is also available along the Northern Pacific Railroad which parallels the U. S. 101 route.

Dry Creek Road connects the Warm Springs Dam site to Healdsburg along the east side of Dry Creek Valley. Canyon, Dutcher Creek, and Lytton Springs Roads provide access to Dry Creek Road from various points in the Alexander Valley. West Dry Creek Road runs along the western side of the valley, but extends only a short distance north of Yoakim Bridge, not reaching the dam site. Connections across the valley are available at Westside, Lambert, and Yoakim Bridges.

Westside Road crosses the southern end of Dry Creek Valley, then turns south, forming the western boundary of the Middle Reach study area. Old Redwood Highway runs south of Healdsburg and joins Eastside Road, comprising the eastern boundary of the valley. Direct access to the Middle Reach is also available from U. S. 101 through Windsor via Windsor River Road and from River Road to the south via Trenton-Healdsburg Road. The only connection across the valley south of the Healdsburg Avenue crossing (R.M. #32) is at Wohler Bridge.

Truck access for sand and gravel operations varies with each location. George Brown uses Dry Creek Road and a dirt road between vineyards to reach the gravel bar. The Soiland Dry Creek operation is located at Westside Bridge and is accessible to major routes through Healdsburg. Basalt reaches its Healdsburg pit via the levee along the west bank of the Russian River. Two stream crossings are placed each spring; one through the Russian River below the Memorial Beach Dam and the other across the mouth of Dry Creek. The processing plant is located in close proximity to both U. S. 101 and the Northwestern Pacific Railroad line.

Quarry Products, Inc., Kaiser Sand and Gravel, and Basalt's Doyle operations are located adjacent to the east bank of the river, necessitating haul roads across agricultural lands to reach Eastside Road. A seldom used haul road exists along the east bank between Kaiser's processing plant and the Basalt-Doyle pit. (R.M. #25.5-#26.). Access to Soiland's terrace operation on the MacMurray property is via the Water Agency road on the east bank at Wohler Bridge.

4. Noise

Ambient daytime noise is determined by the existing land uses in the study area. The prevalence of agricultural uses and rural atmosphere result in relatively low background noise levels in all three valleys. The major source of noise is traffic on

U. S. 101. Peak hour traffic volumes generate the highest average levels of noise (83 dB(A)*at 100 feet (Storm, 1975)) from the highway while particular vehicles can generate as much as 90 dB(A) at 50 feet over less than a 2% grade.

Noise levels and attenuation is affected by the distance and nature of the source, its elevation in relation to the listener, topography, wind, vegetation, reflective surfaces, and temperature. Normally, attenuation is about 6 dB(A) with every doubling of distance from the source. Topographic and other barriers reduce and divert noise to some degree. Vegetation is not a significant reducer, but brush and grasses have some dampening effect. Reflective surfaces bounce and amplify noise. Sound tends to travel further uphill than downhill due to reflection off of the ground surface. Night noise levels are significantly lower in the study area due to the reduction in urban activity and traffic.

Alexander Valley

Again, U. S. 101 is the major source of ambient noise in this rural area. Other contributors are local traffic in urban Cloverdale and Geyserville, sand and gravel extraction operations along the river, and rail traffic /75-85 dB(A) at 50 feet (Storm, 1975)/.

* dB = Unit of sound-pressure-squared level. The minimum change in sound intensity detectable by the human ear through a normal range of frequencies and intensities.

dB(A) = The duration of noise level of many frequencies in a manner representative of the human ear response. (Sound level meters contain an A-weighting network.)

See the accompanying table of common noise levels.

TABLE II. C-8
COMMON INDOOR AND OUTDOOR NOISE LEVELS*

Common Outdoor Noise Levels	Noise Level dB(A)	Common Indoor Noise Levels
Jet Flyover at 1000 ft.	-110-	Rock Band
	-	
	-	
	-100-	Inside Subway
	-	Train (New York)
Gas Lawn Mower at 3 ft.	-	
	-	
	-90-	
Diesel Truck at 50 ft.	-	Food Blender at 3 ft.
	-	
	-	
Noisy Urban Daytime	-80-	Garbage Disposal at 3 ft.; Shouting at 3 ft.
	-	
	-	
Gas Lawn Mower at 100 ft.	-70-	Vacuum Cleaner at 10 ft.
	-	
	-	
Commercial Area	-	Normal Speech at 3 ft.
	-60-	
	-	Large Business Office
	-	
Quiet Urban Daytime	-50-	Dishwasher Next Room
	-	
	-	
	-40	Small Theater,
Quiet Urban Nighttime	-	Large Conference
	-	Room
	-	(Background)

Common Outdoor Noise Levels	Noise Level dB(A)	Common Indoor Noise Levels
Quiet Suburban Nighttime	-	Library
	-	
	-30-	
	-	Bedroom at Night
	-	
Quiet Rural Nighttime	-	Concert Hall (Background)
	-20-	
	-	
(NOTE: A ten (10) decibel increase in dB(A) scale doubles the apparent loud- ness of the sound.)	-	Broadcast and Recording Studio
	-	
	-10-	
	-	
	-	Threshold of Hearing
	-	
	-0-	

* Source: Storm Engineering, 1975.

Dry Creek

Low ambient noise levels in Dry Creek Valley have been interrupted temporarily by Warm Springs Dam construction. Increased recreational traffic along Dry Creek Road may prolong higher levels in the valley following construction. At the southern end of the valley, U. S. 101 and urban Healdsburg affect background levels in the agricultural areas. The sand and gravel operation at Westside Bridge also contributes to noise levels.

Middle Reach

Again, ambient levels are most affected by U. S. 101, Northwestern Pacific Railroad, and urban Healdsburg at the north end of the valley. Noise is reduced substantially at the southern end of the valley where agricultural and recreational uses are more predominant. Sand and gravel operations pres-

ently contribute a substantial amount of noise to this area from each of the extraction, processing and transportation of aggregates. However, the noise from those operations located near Healdsburg is relatively unnoticed when it coincides with other noise generating uses.

5. Air Quality

Air quality in the study area is the responsibility of the Northern Sonoma County Air Pollution Control District (NSCAPCD). Standards are set by federal and State law and administered by the Environmental Protection Agency and the State Air Resources Board, respectively. Ambient air quality in the valleys is generally good. Pollutants are chiefly the result of vehicular emissions, agricultural burnings, and industrial processes (lumber mills, aggregate processing, etc.).

Air quality parameters which are potentially affected by aggregate mining operations are vehicular and batch plant emissions and suspended particulates, or dust. Vehicular emissions are controlled by stringent air quality standards placed on vehicle manufacturers subsequent to the 1977 Clean Air Act. Batch plant manufacturers must also meet standards for their products. In addition, scrubbers and other equipment is available to retrofit existing plants. Suspended particulates result from many activities in the study area, such as agricultural burning and sand and gravel extraction.

Ongoing studies begun in the early 1970's attempted to establish a data base on ambient air quality as a means of evaluating the effect of existing and future sources of pollutants. Not unexpectedly, vehicular emissions such as carbon monoxide and oxides of nitrogen were found to be the highest along the major highway, U. S. 101. Within the study area itself, the City of Healdsburg had a 1973 average annual concentration of 0.5-0.75 parts per million (ppm) carbon monoxide (Bay Area Air Pollu-

tion Control District, 1973). The freeway corridor to the north and south of the city averaged 0-0.5 ppm (BAAPCD, 1973). These readings were well below the national standard of 9.0 ppm (8-hour reading; see standards on Table II. C-9).

The same portion of the study area also had the highest annual average concentration of suspended particulates. The annual mean was 30-40 micrograms per cubic meter (ug/m^3) in Healdsburg and 25-30 ug/m^3 in the surrounding area (BAAPCD, 1973). The standard of 60 ug/m^3 was not exceeded in either case. However, monitoring (1972-1976) with a high volume sampler by the NSCAPCD at stations in Cloverdale and Healdsburg showed that the 60 ug standard was exceeded in 1972 at both stations, but gradually decreased each year. 1977 means were about 45 ug/m^3 at Healdsburg and 35 ug/m^3 in Cloverdale (NSCAPCD, 1972-1977).

TABLE II. C-9

AMBIENT AIR QUALITY STANDARDS

<u>Pollutant</u>	<u>California Standards</u>	<u>Federal Standards</u>
1. Ozone (1 hour)	100 ug/m^3	160 ug/m^3
2. Carbon Monoxide	11 ug/m^3 (12 hrs.)	10 ug/m^3 (8 hrs.)
3. Nitrogen Dioxide (annual average)		100 ug/m^3
4. Suspended Particulates (annual mean)	60 ug/m^3	60 ug/m^3
5. Sulphur Dioxide (24 hrs.)	105 ug/m^3	365 ug/m^3

6. Visual and Aesthetic Environment

The rural atmosphere of the valleys in combination with the agricultural uses and stream environ-

ment give the study area a unique aesthetic quality. The stream channels meandering down the valley floors and set against the topographic relief of steep ridges and upland terrain provide a visually stimulating site for travelers and residents of the area. Recreational enthusiasts experience the diversity of visual opportunity created by the river as it meanders back and forth between gravel bars and riparian woodlands. Dry Creek and the Russian River corridors have both been identified as Unique Features on the Critical Open Space Map of the Sonoma County General Plan.

Alexander Valley

Two areas have been identified as being of scenic significance in the Alexander Valley. The upland terrain west of the river near Chianti is one scenic area. It lies between Highway 101 and the river in the vicinity of the Asti Winery. The other includes the area around Lytton, immediately to the east of the study area along Alexander Valley Road.

Dry Creek

The relatively smaller size of the Dry Creek Valley gives it a quaint quality not as evident in the Alexander Valley, especially in the upstream reaches. Farther to the south near Healdsburg, the valley is larger and in close proximity to Healdsburg, U. S. 101 and Dry Creek Road. As a result, more people have an opportunity to appreciate the scenic beauty of the valley in this area.

Middle Reach

The Middle Reach is highlighted by the winding of the Russian River through the canyons around Wohler Bridge. In addition, the hills to the east of the valley are of critical visual importance as is Westside Road, a Scenic Corridor in the Sonoma County General Plan.

7. Public Services and Utilities

Road maintenance is the primary public service provided in the study area which is related to sand and gravel extraction, processing, and transportation. County roads include all of those mentioned in the section on Circulation (7), with the exception of U. S. 101 and State Route 128. The Sonoma County Road Department provides the maintenance services out of their Healdsburg yard.

OTHER INSTREAM MINING OPERATIONS

There are presently three ongoing instream mining operations in Sonoma County outside of the study valleys. Serres Sand and Gravel extracts gravel from Sonoma Creek north of Boyes Hot Springs. Bohan and Canelis extracts gravel from Austin Creek near Cazadero adjacent to their quarry operation (see beginning of this section). Finally, Gualala Aggregates, Inc. has an extraction operation near Annapolis.

Each of these operations removes gravel by the skimming method from the dry bar. The Gualala operation also consists of a washing and screening plant just off the main channel. A concrete batch plant and crushing facility were previously moved to another site. Bohan and Canelis operates a screening and washing plant as well, but across Austin Creek Road from the extraction site. The Serres operation also includes equipment storage, a repair barn, and a batch plant.

1. Serres Sand and Gravel

The Serres operation is located near Madrone Road in the Sonoma Valley. Sonoma Creek gravels are removed periodically from a dry portion of the streambed where the creek widens. Access to the bar is achieved through the thin strip of riparian growth on the east bank of the creek. Hauls from the site use Highway 12. Immediately to the east

of the riparian strip is the various onsite equipment. Apparently, annual removal does not exceed recharge although further data are needed to so determine.

Neighboring land uses are mostly agricultural. The lands surrounding the site are designated as orchard and vineyard on the General Plan Land Use Map, and Managed Resource (Agriculture) on the Resources and Undeveloped Areas Map. Sonoma Creek and its riparian corridor are designated as a Unique Feature on the Critical Open Space Map.

2. Gualala Aggregates

A bar on the Gualala River is mined by this operation near Annapolis. Gravels are skimmed from the bar and processed just south of the channel banks. According to a 1976 site reconnaissance, the annual removal is somewhat less than apparent recharge (Storm, 1976), although some problems with bank stability have been experienced near the processing site. Access to the site is from Annapolis Road. A sediment basin is currently in use to protect against siltation of the streambed. Surrounding terrain is coniferous forest above the flood plain and channel gravels.

The site is designated as Undeveloped on the General Plan Land Use Map and Managed Resource (Agriculture and Timber) on the Resources and Undeveloped Areas Map. The Gualala River and its riparian corridor is a Unique Feature on the Critical Open Space Map.

3. Bohan and Canelis (See "Description of Existing Environment: Quarries" in this section.)

The extraction area includes both east and west sides of the channel immediately to the west of the hardrock cut. The processing plant is situated between the creek and the quarry. Stockpiles of classified materials exist in the gross channel near the

streambank. Sediment settling basins trap wash water and prevent its entrance into the live summer channel. Gravel recharge has been monitored by the operators, although it is presently unknown whether extraction is more or less than annual recharge.

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SECTION 2

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SONOMA COUNTY PLANNING DIVISION
ENVIRONMENTAL DATA FILE

Maps

1. Mineral Resources
2. Mineral Resources, Open Space Phase I
3. Well Yield
4. Resources and Undeveloped Areas, 1978
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8. Soils Map, 1972
9. Erosion Hazard, 1972
10. Prime Soils, 1972
11. Groundwater Availability, 1972
12. Natural Recharge Areas, 1972
13. Hydrology, 1974
14. Climate, 1974
15. Climate: Precipitation
16. CO Distribution, 1973
17. Suspended Particulates, 1973
18. Sensitive Biotic Areas, 1976

19. Vegetation, 1974
20. Unique Biotic Areas, 1976
21. Rare and Endangered Species, 1976
22. Wildlife Habitats, 1972
23. Slope Map, 1972

Subjects

1. Resources: Agriculture
Minerals
Energy
Water
Soils
Climate

2. Public Safety
3. Biogeography
4. Open Space

USGS Quad Maps

Guerneville
Geyserville
Cloverdale
Healdsburg

Jimtown
Healdsburg
Warm Springs Dam

III. AGGREGATE USE, SUPPLY, AND DEMAND

AGGREGATE USE AND SPECIFICATIONS

Use:

In order to ensure that aggregate materials possess the necessary physical properties for particular construction uses, governmental agencies and other major consumers have established specifications for aggregate quality. Based on standard testing procedures developed by such groups as the American Society for Testing Materials (ASTM) and the American Association of State Highway Officials, these specifications have been refined over a number of years of experience under both laboratory and field conditions.

Among the agencies which specify aggregate quality in Sonoma County are the U. S. Army Corps of Engineers, the California Department of Transportation (CALTRANS), the Sonoma County Department of Public Works, and the incorporated cities of Sonoma County. Others include the Sonoma County Water Agency, Health Department, and Building Department, as well as various sanitation and school districts. Private consumers of aggregate materials include Pacific Gas and Electric Company, Pacific Telephone Company, Northwestern Pacific Railroad, and numerous contractors and building materials supply firms.

Specifications vary considerably depending primarily upon the end product and its intended use. However, for most specified uses, rock materials must be relatively clean and free from organic matter and deleterious substances, durable and resistant to wear, and of proper size, shape and texture.

The following section describes in more detail the necessary physical properties and testing procedures used to determine aggregate performance for each

major use category; concrete, asphalt concrete and asphalt concrete base, road base, road subbase, various fills, and other uses. Refer to the accompanying table for a quick assessment of testing requirements for these use categories.

AGGREGATE PROPERTIES AND TEST DESCRIPTIONS BY USE CATEGORY

A. Concrete Aggregates

Specifications for aggregates used in Portland Cement concrete are more stringent than for most uses. In addition, the large variety of users of concrete means that specifications vary widely. However, in most cases concrete aggregates are evaluated by characteristics such as strength (in concrete), abrasion resistance or durability, chemical stability, soundness, particle size distribution, lack of organic matter and other deleterious substances, and particle shape and texture. The following test methods are commonly employed to determine whether an aggregate will meet the above suitability standards for concrete.

1. Strength by the 28-day compressive strength test.

This test measures the performance of the concrete mix under applied pressure for a 28-day period. In general, the higher the pressure thresholds that the concrete can be designed to withstand, the better the structural performance.

2. Abrasion Resistance by the Los Angeles Rattler Method. (California Test Method #211).

This test is an indicator of an aggregate's ability to resist breakage when subjected to intense abrasion similar to that which would occur on highway surfaces or heavy-duty ware-

TABLE III.-1.

TESTING REQUIREMENTS FOR VARIOUS USES

Aggregate Properties and Tests

Use	Gradation	Cleanness	Compaction	Sand Equivalent	Lack of Organic Impurities	R-Value	Compressive Strength	Abrasion Resistance	Durability	Soundness	Chemical Stability	Particle Shape & Texture	Specific Gravity	Film Stripping
	T.M. 202	T.M. 227		T.M. 217	T.M. 213	T.M. 301		T.M. 211	T.M. 229	T.M. 214				
1. Concrete	X	X		X	X		X	X		X	X	X	X	
2. Asphalt Concrete	X	X		X	X			X				X		X
3. Base	X	X	X	X		X			X			X		
4. Subbase	X	X	X			X								
5. General Fills	X		X	X		X								
6. Trench Backfill	X	X	X	X		X			X					
7. Pipe Bedding	X	X	X	X					X			X		
8. Road Surfaces	X	X			X			X				X		X
9. Drain Rock	X	X												
10. Railroad Ballast	X	X												
11. Riprap	X				X				X			X	X	

Do not type to the left of dotted line.

40 DAY REVIEW ok per KT

COVER SHEET for FEDERAL GRANT APPLICATION/AWARD NOTIFICATION
and/or other Project Reviews - STATE OF CALIFORNIA

1 APPLICATION DATE
yr mo day
19 80 02 08

ITEMS 1-11 TO BE COMPLETED BY APPLICANT

3. APPLICANT - Organizational Unit
SONOMA COUNTY PLANNING DEPARTMENT

4. ADDRESS - Street or P. O. Box
2555 MENDOCINO AVE

2 FEDERAL EMPLOYER ID NO

5. CITY
SANTA ROSA

6. COUNTY
SONOMA

7. STATE 8. ZIP CODE
CA 95401

9. PROJ TITLE/NO. (Catalog of Fed Domestic Assistance)
80.000

10. TYPE OF ACTION
☒ New ☐ Modification
☐ Continuation

TYPE OF CHANGE (Complete if 10b or 10c was checked)
11. ☐ Increased Dollars
12. ☐ Increased Duration
13. ☐ Other Scope Change
14. EXISTING FED GRANT

15. REQUESTED FUND START
yr mo 19 80

19. APPLICANT TYPE
A. State B. School District
C. Interstate D. Community Action Agency
E. Sub State Dist F. Sponsored Organization
G. County H. Indian
I. City J. Other (Specify in Remarks)

FUNDS REQUESTED (For Changes Show Only Amt. of Inc. (+) or Dec. (-))
20. FEDERAL 1 \$
21. STATE 1 \$
22. LOCAL 1 \$
23. OTHER 1 \$
24. TOTAL (20, 21, 22, 23) 1 \$

16. FUNDS DURATION
yr mo (Months)

17. EST. PROJECT START
yr mo 19 80

18. EST. PROJECT DURATION
yr mo (Months)

25. BRIEF TITLE OF APPLICANT'S PROJECT
AGGREGATE RESOURCES MANAGEMENT PLAN

26. DESCRIPTION OF APPLICANT'S PROJECT (Purpose)
MASTER ENVIRONMENTAL ASSESSMENT OF THE LOCATIONS OF EXISTING
AGGREGATE MINING OPERATIONS AND PROPOSED SPECIFIC PLAN FOR
OBTAINING AGGREGATES NECESSARY TO MEET FUTURE DEMAND FOR
CONSTRUCTION MATERIALS. NOP REVIEWED UNDER
SCH# 78110641

27. AREA OF PROJECT IMPACT (Indicate City, County, State, etc.)
SONOMA, MARIN, NAPA, MENDOCINO COUNTIES

28. CONGRESSIONAL DISTRICT
Of Applicant Districts Impacted By Project
[02] [02]

29. Environmental Assessment Required
By State/Federal Agency? ☒ Yes ☐ No

30. CLEARINGHOUSE(S) TO WHICH SUBMITTED
a ☒ State b ☐ Area Wide c ☐ None

31. a NAME/TITLE OF CONTACT PERSON
GREGORY N. CARR/PLANNER

b ADDRESS - Street or P. O. Box
2555 MENDOCINO AVE RM 105A SANTA ROSA, CA 95401

31. d IS ENVIRONMENTAL DOCUMENT REVIEW REQUIRED YES ☒ NO ☐
If Yes ☒ Environmental Impact Statement (Report) Attached (20 copies)
☐ Draft EIR ☐ Final EIR
☐ Negative Declaration Attached (20 copies)
None attached - Document Will Be Forwarded On
Approximately Mon Day Year

e Will the project require relocation? YES ☐ NO ☒
f Does your agency have a civil rights affirmative action policy and plan? YES ☐ NO ☒
g Is project covered by A-95, Part IV? YES ☐ NO ☒
If yes, is MOA executed? YES ☐ NO ☒

If No ☐ Federal Program Does Not Require An Environmental Document
Project Exempt Under State Categorical Exemption, Class

h If project is physical in nature or requires an environmental document, list the U.S. Geologic Survey Quadrangle map in which project is located.
Various

ITEMS 32-38 TO BE COMPLETED BY CLEARINGHOUSE

32. CLEARINGHOUSE ID 300 ☐ MULTIPLE CLEARINGHOUSE 09 09 09 99

33. a ACTION BASED ON REVIEW OF
☒ Notification ☐ Application

33. b ACTION TAKEN
a ☐ With Comment c ☐ Waived
b ☐ Without Comment d ☐ Unfavorable

34. STATE APPLICATION IDENTIFIER (SAI) c A 81002112106 1

35. CLEARINGHOUSE IMPACT CODE
STATE WIDE ☐ Yes ☒ No
County/ City County/ City County/ City County/ City
Ping Area Ping Area Ping Area Ping Area
49 21 28 23

STATE CLEARINGHOUSE
1400 TENTH STREET, SACRAMENTO, CA 95814
(8) 485-0613

Clearinghouse Contact: Anna - 40 day review -
Review Period Began: 02/14/80
Department Review to Agency By: 03/16/80
Agency Review to Clearinghouse By: 03/21/80
Clearinghouse Compliance By: 03/25/80

to 2/16/80
RESOURCES AGENCY
CONSERVATION
FISH AND GAME
PARKS AND RECREATION
DEPT OF WATER RESOURCES
STATE WATER RESOURCES
SOLID WASTE MGMT BOARD
STATE LANDS COMMISSION
DEPT OF FORESTRY
BAY CONS DEV COM

PART 4	NO COMMENTS	COMMENTS ATTACHED	REVISED	Amended Applic. Received	REVISED	Rev. Expected Action Date	54. Exp. Action Revised As Of	REVISED	Subsequent met Applicant
45. ORGANIZATIONAL UNIT				yr mo day		yr mo day	yr mo day		yr mo day
46. ADMINISTERING OFFICE				19 80 02		19 80 02	19 80 02		19 80 02
47. ADDRESS - Street or P. O. Box									
48. CITY									
49. STATE									
50. ZIP CODE									
51. TELEPHONE NUMBER									

ITEMS 55-65 TO BE COMPLETED BY THE FEDERAL OFFICE APPROVING THE GRANT APPLICATION

55. a ☐ Awarded b ☐ Rejected c ☐ Withdrawn
60. FEDERAL AMOUNT (FY funds) 1 \$

house floors and loading docks. A maximum percentage of loss is allowed for a sample revolving inside a drum with steel balls for a specified number of revolutions.

3. Chemical Stability

Various tests are made to determine whether an aggregate will react chemically with cement or other external influences. Reactivity can cause a premature deterioration of the concrete.

4. Soundness (California Test Method #214).

The amount of fissures in the aggregate particles is determined by alternate soaking in sodium or magnesium sulphate solution and drying. This test is essentially a measure of the aggregate's strength.

5. Particle Size Distribution or Gradation by sieve analysis (California Test Method #202).

An aggregate sample is sifted through a series of screens with openings of progressively smaller size. Limits are specified for the percentage of aggregates passing through each screen or mesh size. A proper gradation of particle sizes will minimize void spaces in the mix and influence workability, water and cement requirements, and other factors.

6. Cleanness, Lack of Organic Matter and Other Deleterious Substances (California Test Method #213, 217, 227).

The presence of various unwanted substances in the aggregate can be detected in several ways. One test is simply an examination to determine how well coarse aggregate has been washed. The sand equivalent test (Cal. T.M. #217) measures the amount of clays present

in fine aggregate. Another test measures the amount of organic impurities (Cal. T.M. #213) present by mixing the particles in a chemical color solution.

7. Particle Shape and Surface Texture

The shape and surface texture of aggregate particles is determined by an examination with the naked eye. An overabundance of flat or elongated particles can result in a wet concrete mix that is not as workable as one with rounded or roughly cubical pieces.

B. Asphalt Concrete and Asphalt Concrete Base Aggregates

Specifications for aggregates for asphalt concrete and asphalt concrete base are somewhat less stringent than those which apply to Portland Cement concrete aggregate. The asphalt binder is more plastic or flexible than cement binder. As a result, gradation and particle size and shape specifications are different. However, durability and cleanness (lack of fines) remain required properties according to State specifications developed by CALTRANS and used by most public works agencies.

1. Gradation or Particle Size Distribution by sieve analysis (California Test Method #202).

Maximum particle sizes required for types A and B asphalt concrete and base are smaller than those specified for concrete aggregates. In addition, a higher percentage of fine particles are allowed.

2. Particle Shape and Texture

The interlocking of fractured pieces and resultant friction factor yields better stability with a "plastic binder". As a result,

a particular percentage of crushed particles is usually specified. ("Crushed" is defined as having at least one fractured face.)

3. Abrasion Resistance by the Los Angeles Rattler Machine (California Test Method #211).

Same as for concrete aggregates.

4. Cleanliness and Lack of Clays and Silts by sand equivalent test (California Test Method #217).

By measuring the amount of suspended materials in solution after shaking, the amount of clays and fines is determined. Excess clays can absorb moisture and can affect the stability of the concrete.

C. Road Base Aggregates

Specifications for aggregates used as road base generally allow an increased percentage of coarse materials compared to those for asphalt concrete. Base materials, with the exception of cement-treated base, support the road surface without a binding agent as in asphalt or concrete. Durability, cleanliness, and structural stability are, therefore, important properties.

1. Gradation by sieve analysis (California Test Method #202).

Road base aggregates are normally specified to be of slightly coarser gradation than that for asphalt concrete.

2. Resistance (R-value) (California Test Method #301).

The R-value is a relative measure of the material's resistance to lateral movement from vertical pressure. The R-value assigned

falls between 0 (balloon) and 100 (steel). The test is a general indicator of the aggregate's durability.

3. Cleanliness by sand equivalent (California Test Method #217).

Same as for concrete aggregates.

4. Durability by the Durability Index Test (California Test Method #229).

This test measures the ability of an aggregate to resist breakdown under water and heavy traffic use.

D. Road Subbase Aggregates

Specifications for subbase aggregates are the least stringent of the four major use categories mentioned so far. Gradation requirements are less exacting and durability testing is not required. However, since the subbase, like untreated base, must remain in place without a binder, cleanliness from excess clays and resistance to lateral movement are essential. The subbase must also be readily compactible and clean of vegetable matter. Four or five classes of subbase can be specified with varying gradation requirements for each.

1. Gradation by sieve analysis (California Test Method #202).

For each of three classes of road subbase aggregates a relatively wide range of particle size is allowed. Two other classes permit the use of native materials excavated locally.

2. Cleanliness by sand equivalent (California Test Method #217).

The subbase layer can be affected by the presence of excess clays in a manner similar to that previously described. In general, a higher percentage of clays is allowed in subbase than in base.

3. Resistance or R-value (California Test Method #301).

The subbase layer must also be resistant to movement if the roadbed is to remain stable. R-value requirements are generally lower for subbase than for base.

E. Fills

Generally, the least exacting requirements apply to materials of this category. However, those for uses such as pipe bedding or trench backfill are more stringent. Specifications for fill vary considerably depending on the intended use. Many fills used for roads in rural areas perform adequately while meeting no standard specifications. However, most structure backfills must meet minimum requirements for gradation (Cal. T.M. #202), compactibility (Cal. T.M. #216), cleanness from excess clays (Cal. T.M. #217), and R-value (Cal. T.M. #301).

Trench Backfill and Pipeline Bedding

Trench backfill specifications have been established by both public agencies and private companies. Materials used for these purposes must be durable enough to resist breakdown and generally free from excess clays to minimize absorption of moisture and subsequent expansion (Cal. T.M. #217). Compactibility (Cal. T.M. #216) is also a consideration. Many consumers require that backfill aggregates meet the specifications for Class II aggregate base.

Pipeline bedding materials are often specified

to be rounded, or cubical, so that pipes of vulnerable composition are not damaged by sharp fragments. Compactibility is a factor as well as chemical stability in some cases.

F. Other Uses

1. Drain Rock:

Specifications for drain rock in septic systems are generally limited to cleanness and gradation. The filtering capacity of the rock is encouraged by designating only mid-range sizes.

2. Railroad Ballast:

Railroad ballast materials must be of proper gradation and cleanness. Northwestern Pacific Railroad usually specifies "river run" gravels.

3. Riprap:

Rock used for slope and streambank protection must be durable, relatively non-porous, and stable after placement. Gradation specifications require large-sized boulders in most cases. Resistance to wear is tested by the durability index test (Cal. T.M. #229) and specifications normally require approximately the same durability as road base. Rock which is porous and absorbs moisture is not suitable for this use. Riprap must also meet certain specifications for specific gravity, an important property in stabilizing streambanks when subjected to water flow.

4. Road Surfaces and Coverings:

The various types of road surfaces are directly subjected to stress from traffic and weather. As a result, specifications for

these uses deal primarily with durability, moisture protection, and skid resistance. Durability is determined by the Los Angeles Rattler Method (Cal. T.M. #211). For protection from moisture, an asphaltic oil coating is applied to the aggregate. The affinity of the aggregate for the oils is determined by a "film-stripping" test (Cal. T.M. #302). Gradation, cleanness, and particle shape are also important considerations. Skid resistance can be improved using fractured particles.

SPECIFICATIONS OF VARIOUS AGENCIES COMPARED WITH CALTRANS STATE STANDARD SPECIFICATIONS

Specifications for aggregate for particular uses will often differ among agencies, depending on particular concerns and expertise. Furthermore, the establishment of material requirements for some uses often depends upon the availability of particular sources as well as the structural properties of the aggregate.

The standard specifications published and revised by CALTRANS have been used over the years as a guide to local agencies in making their own determinations of aggregate suitability. In fact, most specifications used by the County and its incorporated cities conform very closely to the State standards. However, some differences do exist. Since material requirements are often extremely significant in determining the potential sources of construction aggregates, a comparison among the requirements of several agencies will assist in understanding the suitability of the alternate sources.

The accompanying table compares the specifications of the Army Corps of Engineers, Sonoma, Marin, and Napa Counties, and various incorporated cities with those developed by CALTRANS.

MATERIAL SUITABILITY AND PROCESSING BY SOURCE

Three sources of aggregate materials are presently being mined in Sonoma County: hard rock, instream, and alluvial terrace deposits. Rock products from each source have particular properties which determine whether they meet various performance standards. The viability of alternative sources for use as aggregate depends primarily on the rock itself, but also on the processing required to prepare the rock. Different consumer specifications and different deposits place different demands on material preparation, but it's possible to make generalizations about source suitability for each use category.

Processing operations normally include site preparation, excavation, crushing, screening, classifying, blasting, product batching, and washing. Other operations used less frequently are those associated with specialty products and the removal of various deleterious substances.

In general, rock from alluvial and instream sources requires less processing per ton than rock from hillside deposits. The difference is due primarily to the amount of crushing and washing necessary before hard rock can produce the finer-sized particles. But the fact that crushed rock which is durable enough to supply concrete materials, for instance, must often be dynamited prior to extraction also adds to the total amount of processing needed for quarry rock.

Current industry estimates place the additional cost (1979 dollars) of concrete aggregates produced from quarry rock deposits at approximately \$0.75-\$1.00 per ton at the plant. This additional cost can be broken down in the following way:

- | | |
|--|-----|
| 1. Blasting operation (materials and labor) = | 15% |
| 2. Extraction operation (ripping and dozing) = | 19% |

TABLE III.-2.

DIFFERENCES IN SPECIFICATIONS (CALTRANS STANDARD)

	U. S. ARMY CORPS OF ENGINEERS (WARM SPRINGS DAM)	SONOMA COUNTY	NAPA COUNTY	MARIN COUNTY	CITIES
CONCRETE	1. Fine: Natural Sand 2. Coarse: Gravel or Crushed Stone 3. Gradation 4. Limit for Flat & Elongated Pieces	1. Gradation 2. Higher Sand Equivalent Required 3. Higher Cleanness Result Required	1. Class "A" Concrete Specified	CALTRANS	CALTRANS
ASPHALT CONCRETE	None Specified	1. Gradation 2. Type "B" is Specified 3. Sand Equivalent Standard is Higher	CALTRANS	Specify Type "A" with Three Fractured Faces Instead of One	1. Type B is Usually Specified 2. Some Differences in Gradation
BASE	1. Limit for Flat & Elongated Pieces 2. Gradation 3. 50% Crushed Rock 4. Lower Loss to Abrasion Accepted	1. No Waiver of R-value Allowed 2. 25% Crushed Pieces 3. Gradation 4. Higher Sand Equivalent Required	1. Class II Base is Specified	CALTRANS	CALTRANS except Cloverdale, which uses Sonoma County specifications.
SUBBASE	None Specified	1. Gradation 2. No Waiver of R-value Allowed 3. Higher Sand Equivalent Required	1. Class II Subbase is Specified	CALTRANS	CALTRANS except Cloverdale, which uses Sonoma County specifications.
FILLS	1. Compaction for "Random Fills" is Specified	For structure backfill, a different gradation and higher sand equivalent is required.	CALTRANS	CALTRANS	CALTRANS
TRENCH BACKFILL AND PIPE BEDDING	1. Two Types of Backfill Specified 2. Gradation for Both Types 3. Sand and Gravel for Type II 4. "Pea Gravel" for Bedding	CALTRANS	1. Pipe Bedding: Imported Fines, Compactible 2. Backfill: Native Materials or Granular if Compactible	1. Pipe Bedding: Pea Gravel, Crushed Rock, or Special Sands 2. Backfill: Native Materials where possible, otherwise Class IIAB	1. Cities differ widely. Some require pea gravel, others native materials where possible. 2. Class II AB is often required for trench backfill.

3. Crushing operation = 26%
4. Labor (extraction and crushing) = 40%

On the other hand, crushed particles are required for some uses. When this is the case, the crushing operation must be undertaken regardless of the source of the material. "Type A" asphalt concrete, for instance, requires a minimum of 90% crushed particles.

Thus, the ability of aggregate from alternative sources to meet standards of performance for particular construction applications is a question, first, of its inherent physical properties and, second, of the extent of processing required. The following evaluation of the viability and suitability of aggregate from alternative sources is based on these two factors.

A. Road Surfaces and Coverings

Specifications for road surfacing can be met by each of the alternative sources. Crushed fragments provide more skid resistance in asphalt oil/rock coverings. However, the smaller sized particles required must be crushed extensively when obtained from most quarries.

B. Riprap and Slope Protection

Instream and alluvial sources cannot provide larger sizes of rock. Certain quarries have rock which can meet all specifications. All three sources can provide sizes smaller than 3"-6". Quarried rock must undergo additional crushing as required sizes diminish.

C. Drain Rock

All three types of sources can make specification drain rock as particle shape is not as important a factor as cleanness and proper gradation. Smaller particles are discouraged, thus increas-

ing the relative viability of quarry rock for this use.

D. Railroad Ballast

"River run" gravels are presently being specified by Northwestern Pacific Railroad. The actual material requirements (gradation and cleanness) can be met by any of the three sources. Gradation requirements limit sand content, thus increasing the viability of quarried rock.

E. General Fills

Materials used for fill are generally required to meet lower compaction standards. In addition, many fills are constructed which meet no particular specifications except "the rock is hard". Agency specifications for sand equivalent, R-value, and compactibility occasionally exclude the use of native fills, but any mining operation, regardless of source, can meet fill specifications for a wide range of uses.

F. Trench Backfill and Pipe Bedding

From a materials standpoint, each of the alternative sources of aggregate in Sonoma County can meet specifications for trench backfill. In many cases, native materials obtained during excavation may also be used for backfill and are often specified by the regulating agency. A drawback to the use of native materials is the difficulty encountered in locating old trenches when excavating for repairs. When rough textured or crushed particles are used for backfilling trenches, compaction is somewhat more difficult to achieve. Rounded materials will compact or "settle" with an application of water, while crushed rock needs additional tamping or vibrating to meet compactibility requirements.

Unlike requirements for trench backfill, those

for pipe bedding materials often limit the potential sources to streamworked aggregates. Crushed rock sources have some limitations for this use. Due to the potential for damage to certain types of pipe from angular rock fragments, Pacific Gas and Electric Company and Pacific Telephone Company often require naturally rounded sands for their pipe bedding. This requirement depends, however, on the composition of the pipe itself. Some pipe materials, such as concrete, are not as susceptible to damage as others. The use of a pipe casing, however, can eliminate this problem altogether.

G. Subbase

Specifications for road subbase aggregates can be met by each of the alternative sources of aggregate. In addition, native materials can often meet subbase specifications for gradation, sand equivalent, and R-value. Hard rock quarries currently supply the bulk of subbase aggregates in Sonoma County.

H. Base

Specifications for road base aggregates can be met by each of hard rock, instream and alluvial sources. Requirements for gradation, sand equivalent, and R-value are more stringent for base than for subbase. Neither these nor additional specifications for durability and particle shape place any limitations on any of the alternatives as sources of supply for base. A small percentage of crushed fragments is usually specified to prevent shearing. A number of hard rock quarries in Sonoma County have problems in meeting R-value and durability specifications consistently due to the poor or inconsistent quality of particular deposits, but base aggregates are currently being supplied by all three sources.

I. Asphalt Concrete and Asphalt Concrete Base

Specifications for aggregate for these uses can be met by all three alternative sources in Sonoma County. Primary requirements for abrasion resistance and sand equivalent can be met by each depending on the geologic nature of individual deposits. Gradation specifications place a priority on finer-grained materials. In order for hard rock operations to supply these finer materials, they must "manufacture" sand by extensive crushing. Depending on whether Type A (90%) or Type B (25%) is specified, a certain percentage of crushed particles is also required. It may be crushed rock from a quarry or crushed gravel from streambed or alluvium deposits. Presently, most asphalt concrete aggregates come from streamworked sources.

J. Concrete Aggregate

Concrete aggregates can be produced from any of the three sources. However, there are limitations to the use of crushed rock. Instream and alluvial sources presently supply most of the Portland Cement concrete aggregate in Sonoma County due to their hardness, resistance to wear, soundness, and workability. While crushed rock from quarries can meet all of the requirements for strength, it results in a less workable wet mix for many uses. In order to improve workability, more water, and therefore more cement, is required. Generally, the angular rock fragments make finishing somewhat more difficult.

Although naturally-occurring sands are present in alluvial terrace deposits, the relative proportion of sands to coarse aggregates in Sonoma County is lower than present demand requires for concrete, asphalt concrete, pipe bedding, and trench backfill. Therefore, these sources oc-

asionally require that supplemental sand sources be mined.

AGGREGATE DEMAND

Future demand for aggregate resources was calculated using the following sources of data and information:

1. Past production records of the aggregate industry, channeled through the U. S. Bureau of Mines and the California Division of Mines and Geology.
2. A survey of County aggregate producers conducted as a part of the Aggregate Study in November, 1978.
3. Population projections for Napa, Mendocino, Sonoma, and Marin Counties by Association of Bay Area Governments (ABAG), California Department of Finance, and the individual counties themselves.
4. Residential and non-residential construction data for above counties from California Department of Finance and counties.
5. Trucking, transportation, and highway construction data from Sonoma County Planning Division, CALTRANS, and Sonoma County Public Works Department.
6. Aggregate use data from Southern California Rock Products Association, Portland Cement Association, and Aggregates and Concrete Association.
7. Taxable retail sales data from State Board of Equalization.

Aggregate Use

Aggregates are used extensively for virtually all types of construction. They are a fundamental in-

gredient in the construction of residences, industrial and commercial buildings, parking lots, roads and highways, dams, bridges, railroads, schools, public utilities, levees, and for decorative purposes.

Rock materials are used in two forms. In loose form with no binding ingredient, aggregates are used primarily as base materials for road and highway construction, as backfill in pipeline trenches, and as permeables in drain and septic systems. Railroad beds, streambank riprap, levees, and other types of fill also require the use of aggregates in unbound form.

Aggregate is also mixed with a binding agent for certain construction applications. Combined with Portland Cement as concrete, aggregates are an important component in both residential and non-residential building construction, including walls, foundations, sidewalks, curbs, driveways, parking lots, city streets, and pipe for sewer and water lines. Combined with asphaltic binding, aggregates provide surfacing and structural material for streets, roads, and highways, driveways and parking lots.

In general, the amount of aggregate used is normally attendant with population growth, although major construction projects have caused production to fluctuate from year to year. During the postwar period in Sonoma County and the other North Bay Counties, a major portion of the aggregate mined has gone to highway construction. However, since the completion of U. S. 101 in the late 1960's, the bulk of aggregate production and use appears to have shifted to residential and related construction.

Production and Market

Sonoma, Marin, Napa, and Mendocino Counties comprise a production-consumption region for aggregate materials. Producers within the region supply virtually

TABLE III-3

ANNUAL AGGREGATE PRODUCTION
BY REGIONAL AND COUNTY SOURCES

* Percent of regional production from Sonoma County sources

Source: California Division of Mines and Geology and U. S. Bureau of Mines

** No production figures are available for Mendocino County.

the entire regional demand. There are some exceptions to the rule, however, such as one particular quarry which supplies decorative rock for the entire Bay Area. As shown in Table III-3, Sonoma County has been the major producer for the production-consumption region, supplying approximately three-fourths of the region's needs.

A further breakdown on Sonoma County production during 1978 (Table III-4) indicates the demand for aggregate materials by end product.

TABLE III-4

Concrete aggregates (coarse and fine)	26.5%
Asphaltic concrete aggregates	12.4
Base aggregates	22.5
Subbase aggregates	12.4
Trench backfill and bedding materials	11.1
Other fill	2.5
Drain	2.7
Other (includes some of above categories)	9.8

Source: Industry Survey, 1978/1979

Approximately one-fifth of the total aggregate mined in Sonoma County has its end use point in Marin, Napa, or Mendocino Counties. Each county comprises a sector of the production-consumption region along with four subregions within Sonoma County, making a total of seven "market" areas or subregions. The use of production-consumption subregions permits a more detailed examination of the locations of aggregate use within the region. The subregion boundaries are derived from the nine "Planning Areas" in Sonoma County. Table III-6 shows the relative percentages of the 1978 Sonoma County aggregate production going to each subregion. (See map.)

TABLE III-5

PRODUCTION BY SOURCE TYPE (%)

Year	Terrace Pit Percent	Instream Russian River Percent	Other Instream Percent	Quarries Percent
1960	--	86.4	3.1	10.5
1961	--	90.7	1.9	7.4
1962	--	92.5	1.9	5.6
1963	--	85.6	4.5	9.9
1964	--	83.8	4.6	11.6
1965	3.9	76.2	6.8	13.1
1966	3.7	77.0	6.1	13.2
1967	36.9	43.4	5.8	13.9
1968	72.2	13.9	0.1	13.8
1969	70.4	12.0	4.5	13.0
1970	66.6	12.8	7.4	13.2
1971	75.1	3.4	10.6	10.9
1972	78.1	6.9	4.4	10.6
1973	72.0	4.3	8.4	15.3
1974	74.1	4.4	8.3	13.2
1975	66.3	3.7	9.4	20.6
1976	66.6	6.0	7.2	20.2
1977	69.0	11.0	--	20.0

-- = None reported.

Source: Manson, California Division of Mines and Geology



TABLE III-6

Location of Use

1. Western Sonoma County (4.5%)
 - a. Coastal Planning Area (1%)
 - b. Russian River Planning Area (3.5%)
2. Northern Sonoma County (6.2%)
 - a. Cloverdale (1%)
 - b. Healdsburg (5.2%)
3. Central Sonoma County (46.8%)
 - a. Santa Rosa (24.3%)
 - b. Rohnert Park/Cotati (18.3%)
 - c. Sebastopol (4.2%)
4. Southern Sonoma County (23.6%)
 - a. Petaluma (15.2%)
 - b. Sonoma (8.4%)
5. Mendocino County (2.4%)
6. Napa County (8.0%)
7. Marin County (8.5%)
8. Other

Source: Industry Survey, 1978/1979

The Central Sonoma County subregion above consumes about one-half of Sonoma County's aggregate production. Next is the Southern Sonoma County subregion, which uses about one-fourth. Together, the two subregions use approximately three-fourths of the aggregate mined in Sonoma County.

On the other hand, most of Sonoma County's production

comes from the Northern Sonoma County subregion. (See Table III-7.) The accompanying map graphically illustrates the relative production and consumption in each planning area in Sonoma County.

TABLE III-7

Location of Production

Western Sonoma County	12.1%
Northern Sonoma County	68.2%
Central Sonoma County	8.5%
Southern Sonoma County	11.2%

Source: Industry Survey, 1978/1979

Future Demand

The State Division of Mines and Geology, in its "Guidelines for Classification and Designation of Mineral Lands", has required that an estimate be made of the total supply of aggregate required in each production-consumption region for a 50-year period.

In forecasting the total aggregate requirement until 2030, past production according to available U. S. Bureau of Mines statistics was compared to several potential growth indicators, including population and population growth rate, residential and non-residential construction, highway construction and maintenance mileage, truck registrations, and taxable sales data.

The strongest correlation with past Sonoma County production was found in the comparison with residential building permit activity. Table III-8 shows this relationship clearly and verifies the use pattern mentioned earlier. The correlation with residential construction is greater since the late 1960's than in the previous years of freeway construction.

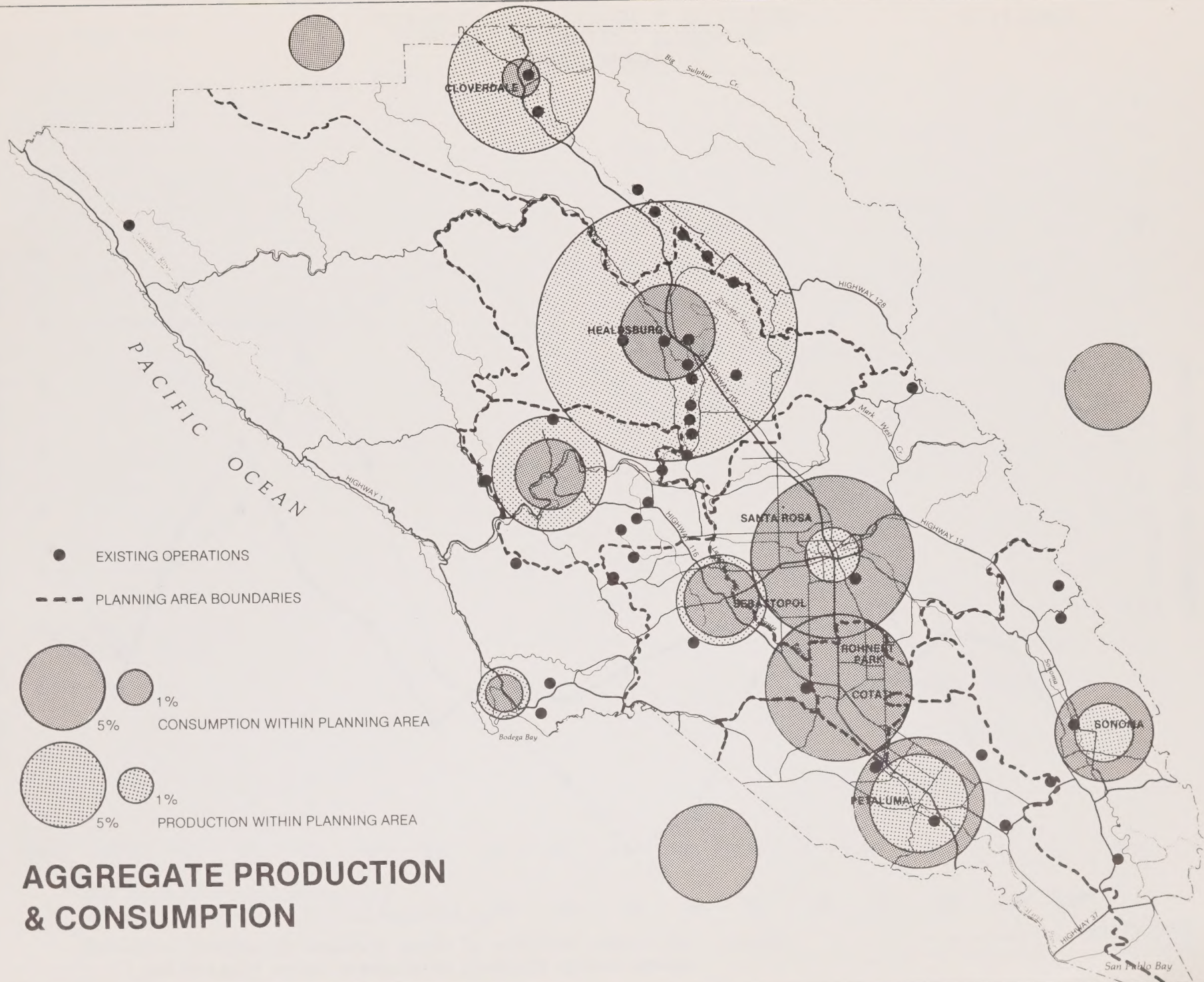


TABLE III-8

CORRELATION OF AGGREGATE PRODUCTION WITH
RESIDENTIAL CONSTRUCTION OVERTIME,
SONOMA COUNTY

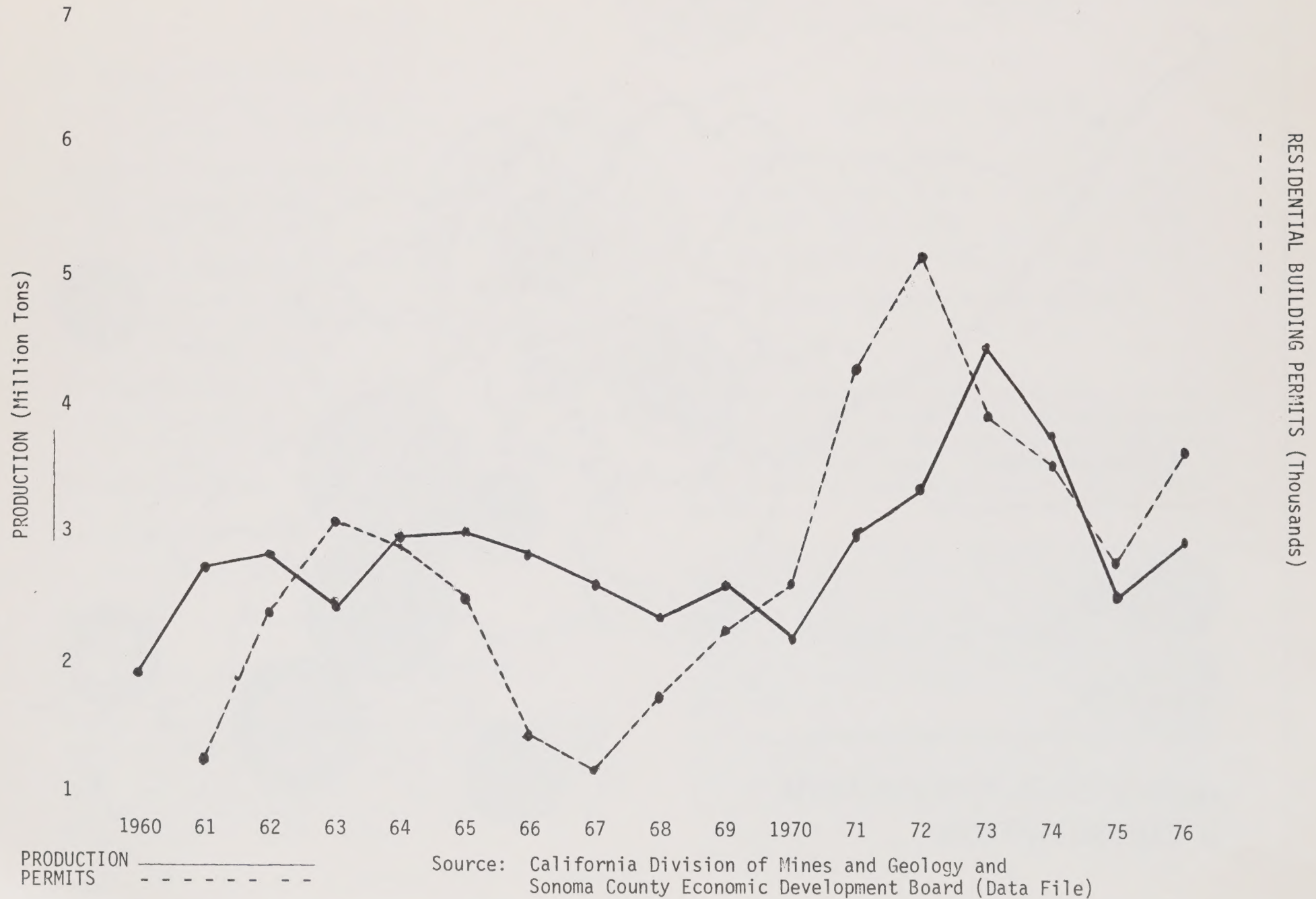
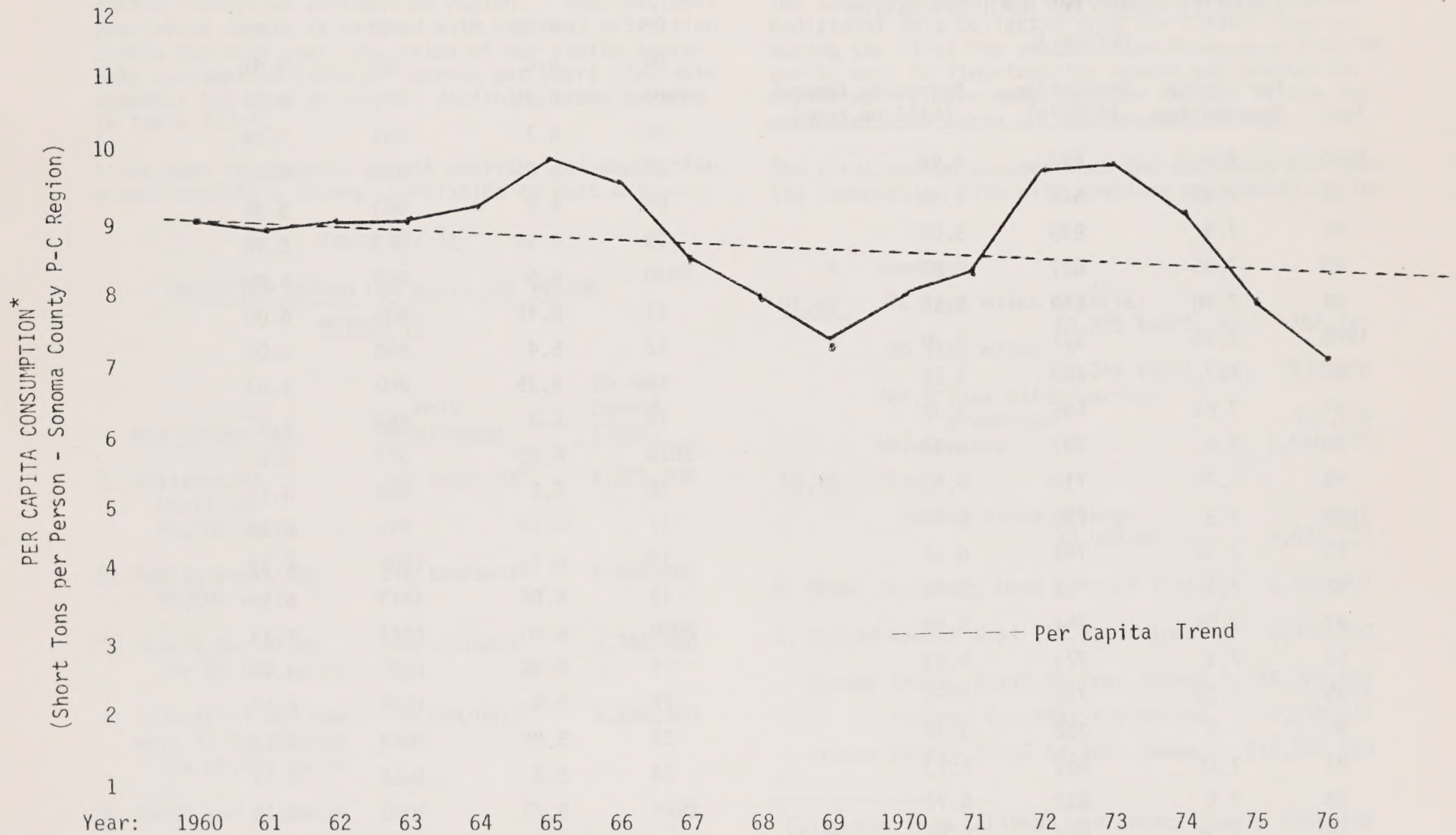


TABLE III-9

ANNUAL PER CAPITA AGGREGATE CONSUMPTION **
FOR THE NORTH BAY REGION



* Mean population and normalized
production based on C.D.M.G. methodology

** Mendocino County not included.

TABLE III-10

PROJECTED DEMAND FOR NORTH BAY REGION

METHOD I

Year	Per Capita Consumption	Population (1000's)	Aggregate Demand (million tons)
1980	8.0	612	4.90
81	7.95	624	4.96
82	7.9	636	5.02
83	7.85	647	5.08
84	7.80	659	5.14
1985	7.75	671	5.20
86	7.7	683	5.26
87	7.65	695	5.32
88	7.6	707	5.37
89	7.55	718	5.42
1990	7.5	730	5.48
91	7.45	741	5.52
92	7.4	751	5.56
93	7.35	761	5.59
94	7.3	771	5.63
1995	7.25	781	5.66
96	7.2	792	5.70
97	7.15	802	5.73
98	7.1	812	5.77
99	7.05	822	5.80
2000	7.0	831	5.82
01	6.95	840	5.84
02	6.9	850	5.87

25.1051.67108.11

Year	Per Capita Consumption	Population (1000's)	Aggregate Demand (million tons)
03	6.85	859	5.88
04	6.8	869	5.91
2005	6.75	879	5.93
06	6.7	887	5.94
07	6.65	895	5.95
08	6.6	903	5.96
09	6.55	913	5.98
2010	6.5	923	6.00
11	6.45	931	6.00
12	6.4	940	6.02
13	6.35	950	6.03
14	6.3	963	6.07
2015	6.25	977	6.11
16	6.2	986	6.11
17	6.15	995	6.12
18	6.1	1005	6.13
19	6.05	1013	6.13
2020	6.0	1021	6.13
21	5.95	1030	6.13
22	5.9	1039	6.13
23	5.85	1048	6.13
24	5.8	1054	6.11
2025	5.75	1060	6.10
26	5.7	1067	6.08
27	5.65	1075	6.07
28	5.6	1084	6.07
29	5.55	1092	6.06

288.92

A fairly strong correlation also exists between production and population growth when examined over the entire production-consumption region. When regional population growth is matched with regional extraction levels for each year, the rates of per capita aggregate consumption (tons per person per year) fluctuate somewhat but show an overall declining trend as seen in Table III-9.

Since both residential permit activity and population growth exhibit a strong correlation to past extrac-

tion levels, two methods were selected for assessing future demand, each based on one of the two factors. The two projections will provide a range of demand. Additional data collected from the mining industry during the first few years of the Management Program can be used to fine-tune the demand and production estimates. In the meantime, the average of the two estimates will serve as the forecast demand.

The first method assumes that the declining per capita consumption rate will continue as population in-

TABLE III-11

PROJECTED DEMAND FOR NORTH BAY REGIONMETHOD II

<u>Use Categories</u>	<u>Unit Requirement</u>	<u>20-Year Demand (Tons)</u>
1. Residential Dwellings 85,000 units	65 ton/unit ⁰	5,525,000
2. Public Works for 85,000 units	116 ton/unit ⁰	9,860,000
3. Public Buildings for 85,000 units	44 ton/unit ⁰	3,740,000
4. Industrial and Commercial Facilities for 85,000 units	54 ton/unit ⁰	4,590,000
5. Roads and Highways ⁺		
A. State:		
20 lane miles new freeway)		
59.2 lane miles freeway)		
widening)		2,273,445
Maintenance)		

B. County:

76 lane miles arterial	
10,325 ton/1. mi.	784,725
30 lane miles 2R	
7,744 ton/1. mi.	232,320
164.5 lane miles various	
widening	933,959
Maintenance	2,686,176

C. City

312.53 added mileage	
12,907/mi.	4,033,721

6. Other In-County Uses (15% of total^{*}) 5,198,901

7. Out-of-County Uses (18.3% of total^{*}) 6,342,660

Sonoma County Total 20-Year Demand = 46,200,907

Average Per Year Extraction 2,310,045

Sonoma County Total 50-Year Demand = 115,502,260

⁺ Estimates from CALTRANS and Sonoma County Planning Division

⁰ Survey of Portland Cement Association, Los Angeles

^{*} Industry Survey, 1978/1979

creases throughout the production-consumption region. At the rate of decline shown in Table III-9, the per capita use in 2030 will drop to about 5.5 tons per person per year from 8.0 in 1980. Regional population by the same time is expected to reach 1,100,000 from a 1980 level of 612,000.

To arrive at a 50-year aggregate demand estimate, each year's projected population is multiplied by its projected per capita use of rock. Table III-10 shows the yearly quantities and totals at 5, 10, 20, and 50-year intervals.

Based on this method, regional aggregate use by the year 2030 will have been 288,920,000 tons. Assuming that Sonoma County producers continue to supply 72.5%* of the region's demand, the 50-year demand on Sonoma County sources will be 209,467,000 tons, and the 20-year demand 78,380,000 tons.

The second method of projecting demand assumes that the housing and other construction needs identified in the Sonoma County General Plan will be met by the year 2000. The uses of aggregate materials were divided into major categories and then assigned quantities for each new unit based on previous research. Then the average annual aggregate production for the period from 1980 to 2000 was extrapolated to the year 2030 for the 50-year estimate. Table III-11 shows the major use categories, the unit aggregate requirements, and the 2000 and 2030 year demand estimated using this method (46,200,907 and 115,502,260 tons). Table III-12 divides these gross figures into estimates of 50-year demand by use category.

The 50-year demand projections derived from the two methods differ by almost 100 million tons (209,500,000 and 115,500,000). However, this discrepancy can be viewed as a range within which the actual demand will most likely occur. As more complete production quantities are monitored on a

yearly basis, along with building permit activity, population, and major aggregate-consuming projects, the demand forecasts will be fine-tuned and provide a more accurate estimate of the future use of aggregate materials. At this time, the estimated 20-year demand is 62,250,000 tons and 50-year demand is 165,000,000 tons.

AGGREGATE SUPPLY

The following classification and quantification of Sonoma County's aggregate reserves will be described using mineral resource terminology re-

TABLE III-12

50-YEAR DEMAND

	<u>Method 1*</u>	<u>Method 2*</u>
	<u>(Population)</u>	<u>(Residential)</u>
Concrete aggregate 26.5%	55,509,000	30,608,000
Asphalt concrete 12.5%	26,183,000	14,437,000
Base 22.5%	47,130,000	25,988,000
Subbase 12.4%	25,974,000	14,322,000
Trench backfill 11.1%	23,251,000	12,821,000
Other fill 2.5%	5,237,000	2,888,000
Drain 2.7%	5,655,000	3,119,000
Other 9.8%	20,528,000	11,319,000
Total 100.0%	<u>209,467,000</u>	<u>115,502,000</u>

* Average from 1960 to 1976. (See Table III-3.)

* Numbers are rounded to nearest 1,000.

cently adopted by the U. S. Bureau of Mines and the U. S. Geological Survey. "Mineral resources", in this Study, refers to deposits that might become economic sources of aggregate in the future. The term "mineral reserves" is a subcategory of mineral resources and refers to identified, economically viable deposits of rock.

Reserves are further classified by source type, deposit homogeneity, and degree of confidence in quantitative estimates. Table III-13 outlines the classification system used herein.

A complete estimate of the available mineral aggregate resource in Sonoma County is virtually impossible. Both alluvial and hardrock deposits are outlined on existing geologic maps, but their suitability for use in construction aggregate production often remains in question. Alluvial deposits frequently contain clay or silt layers or a high percentage of clay content within sand and gravel layers. Similarly, hardrock deposits frequently consist of veins of tuffs, breccias, or other "soft" rock interbedded between layers of potential resource. Geologic research in conjunction with this Study, though, has provided estimates of the reserves available within the Study area valleys and existing and potential hardrock sites.

Major alluvial areas in Sonoma County include those associated with Santa Rosa Creek, the Petaluma River, and Sonoma Creek. Much of the potential resource in these three basins, however, is mixed with a high percentage of clays, and silt. In addition, a major portion of the resource in each basin has been lost to urban development.

Hardrock resources are found in deposits of Franciscan sandstone and greenstone and basalt of the Sonoma Volcanics Group. Deposits are located in the Sonoma Mountains, the Sonoma-Napa Mountains the Mayacamas Range, the rolling terrain west of

Rohnert Park, Cotati, and Petaluma, the Pocket Canyon/Occidental area, etc. Some of the deposits consist of massive blocks of resource suitable for all uses, others are floaters or isolated small deposits, while others contain veins of lesser quality materials suitable only for fill purposes. Alluvial reserves are mapped on "Geology and Aggregate Reserves" on the following pages.

The extensive use of instream and alluvial terrace aggregates from Sonoma County deposits over the years has established the reliability of these sources for hard durable rock suitable for many uses. Testing results of river aggregates are recorded by the Sonoma County Department of Public Works, CALTRANS, and other agencies. Many of the tests described earlier in this section have been performed on these materials. This Study has proceeded on the evidence that these materials are of adequate quality to warrant their consideration as a potential source of future aggregate materials.

Most of the existing hardrock quarries in Sonoma County have produced primarily subbase and fill materials in the past. In recent years, though, some quarries have established themselves as reliable producers of specification aggregate for such uses as road base and asphalt concrete. In order to determine whether or not hardrock sources could supply materials of adequate quality, an extensive reconnaissance of existing and potential deposits was undertaken. A survey of existing sites and an examination of previous test results led to the conclusion that certain geologic formations contained likely aggregate reserves, while others did not. Using the most recent geologic mapping of the County as a guide, staff and the reconnaissance team selected the promising geologic areas to be field surveyed according to the following criteria:

1. Potential suitability of the rock deposit
2. Proximity of the deposit to market areas



Match Line Map A-2

AGGREGATE RESERVES



INSTREAM RESERVES



TERRACE RESERVES; PRIMARY

GEOLOGY



YOUNGER ALLUVIUM AND
STREAM CHANNEL DEPOSITS



(B) BEDROCK FORMATION

Russian River, Alexander Valley Cloverdale Section Map A-1 GEOLOGY AND AGGREGATE RESERVES

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
0 900 1800 Meters



AGGREGATE RESERVES

-  INSTREAM RESERVES
-  TERRACE RESERVES; PRIMARY
-  TERRACE RESERVES; SECONDARY

GEOLOGY

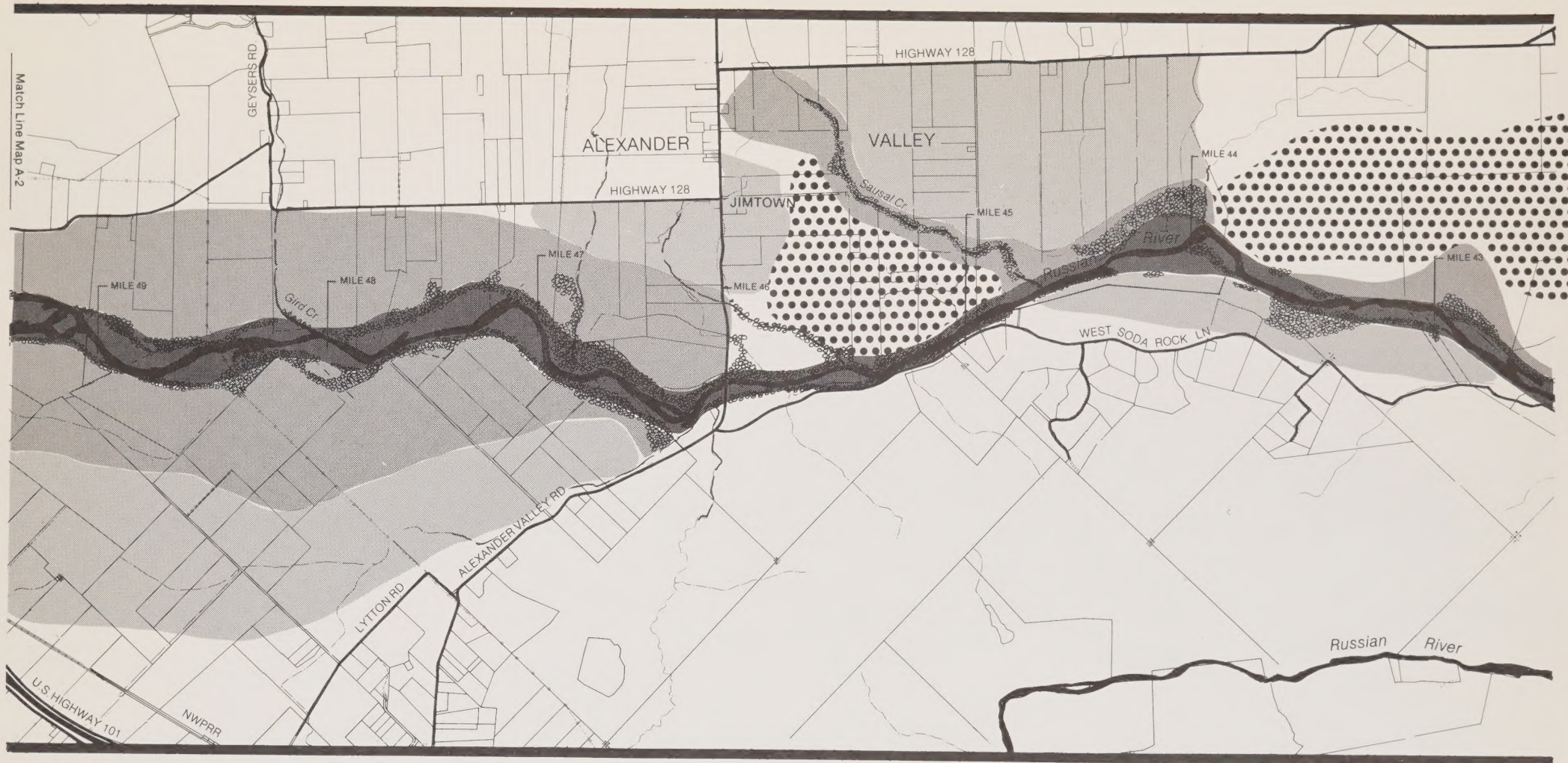
-  YOUNGER ALLUVIUM AND STREAM CHANNEL DEPOSITS
-  (B) BEDROCK FORMATION

Russian River, Alexander Valley Geyersville Section Map A-2 GEOLOGY AND AGGREGATE RESERVES

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
0 900 1800 Meters



AGGREGATE RESERVES

-  INSTREAM RESERVES
-  TERRACE RESERVES; PRIMARY
-  TERRACE RESERVES; SECONDARY

GEOLOGY

-  YOUNGER ALLUVIUM AND STREAM CHANNEL DEPOSITS
-  (B) BEDROCK FORMATION

Russian River, Alexander Valley Jimtown Section Map A-3

**GEOLOGY AND
AGGREGATE RESERVES**
Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
0 900 1800 Meters



AGGREGATE RESERVES

-  INSTREAM RESERVES
-  TERRACE RESERVES; PRIMARY
-  TERRACE RESERVES; SECONDARY

GEOLOGY

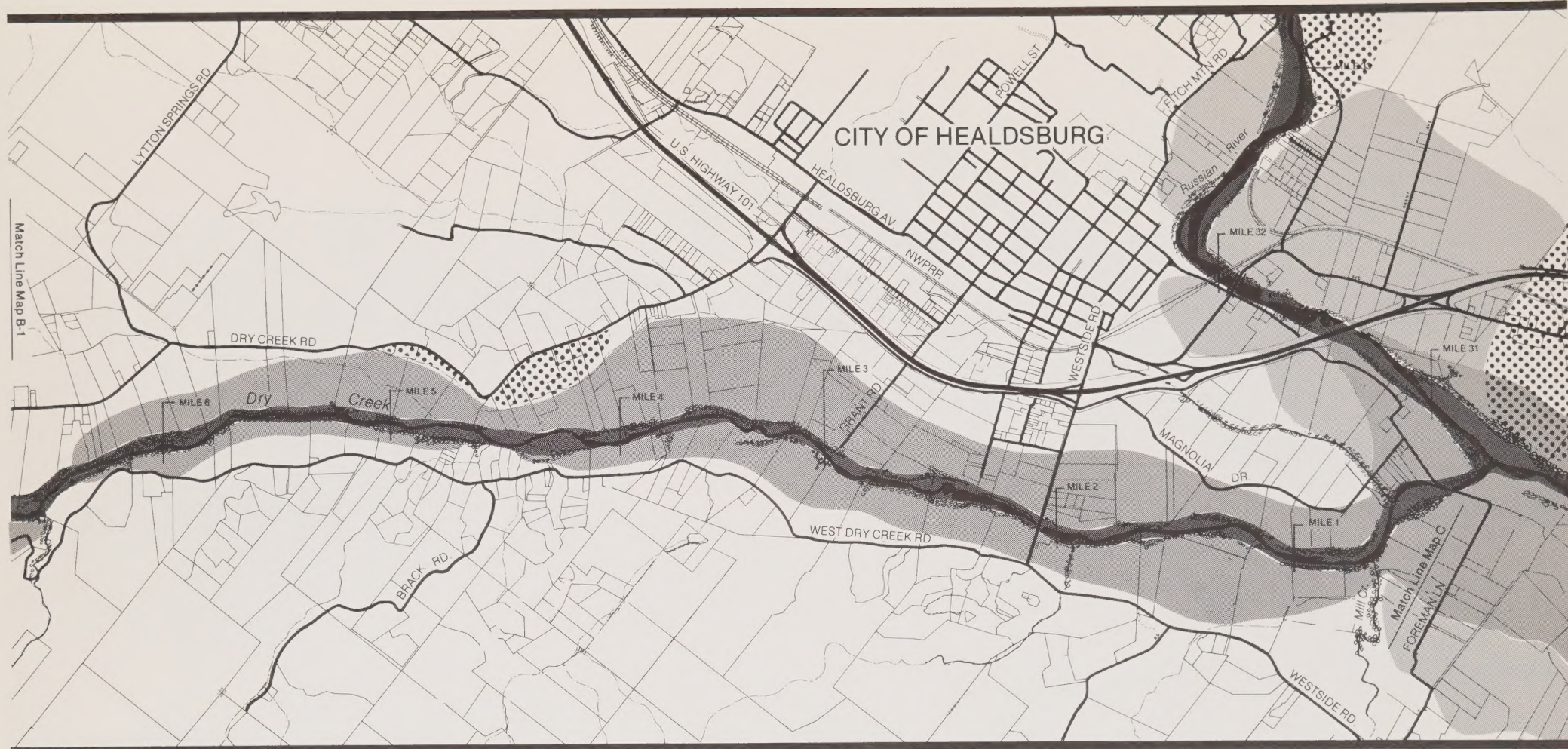
-  YOUNGER ALLUVIUM AND STREAM CHANNEL DEPOSITS
-  (Qt) ELEVATED TERRACE DEPOSITS

Dry Creek, Dry Creek Valley Yoakum Bridge Section Map B-1 GEOLOGY AND AGGREGATE RESERVES

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
0 900 1800 Meters



AGGREGATE RESERVES

-  INSTREAM RESERVES
-  TERRACE RESERVES: PRIMARY
-  TERRACE RESERVES: SECONDARY

GEOLOGY

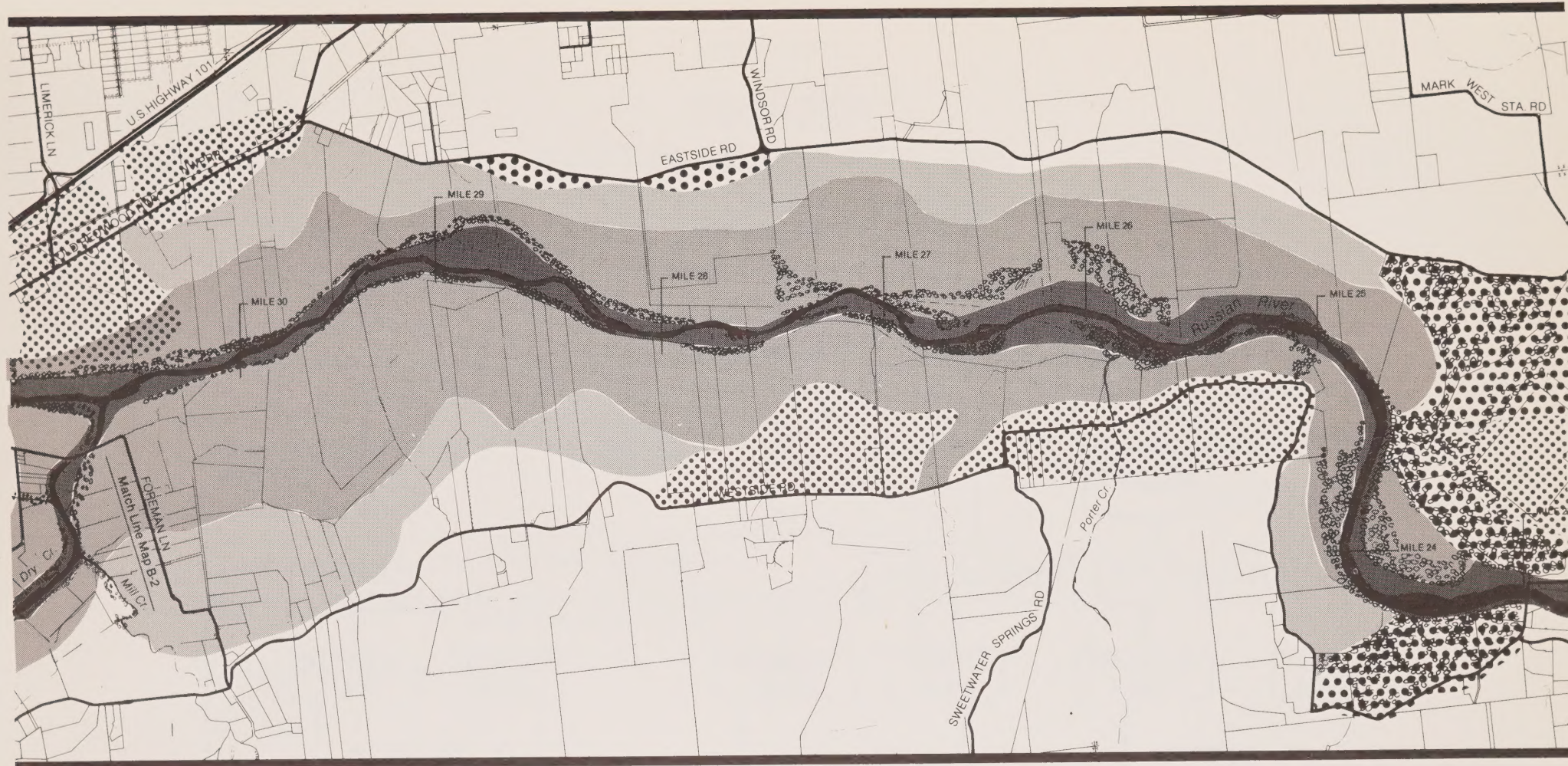
-  YOUNGER ALLUVIUM AND STREAM CHANNEL DEPOSITS
-  (Q1) ELEVATED TERRACE DEPOSITS

Dry Creek, Dry Creek Valley Healdsburg Section Map B-2

**GEOLOGY AND
AGGREGATE RESERVES**
Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
0 900 1800 Meters



AGGREGATE RESERVES

-  INSTREAM RESERVES
-  TERRACE RESERVES; PRIMARY
-  TERRACE RESERVES; SECONDARY

GEOLOGY

-  YOUNGER ALLUVIUM AND STREAM CHANNEL DEPOSITS
-  (Qt) ELEVATED TERRACE DEPOSITS
-  (B) BEDROCK FORMATION

Russian River, Middle Reach Map C

GEOLOGY AND AGGREGATE RESERVES

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
0 900 1800 Meters

TABLE III-13
CLASSIFICATION OF RESOURCE AND RESERVES

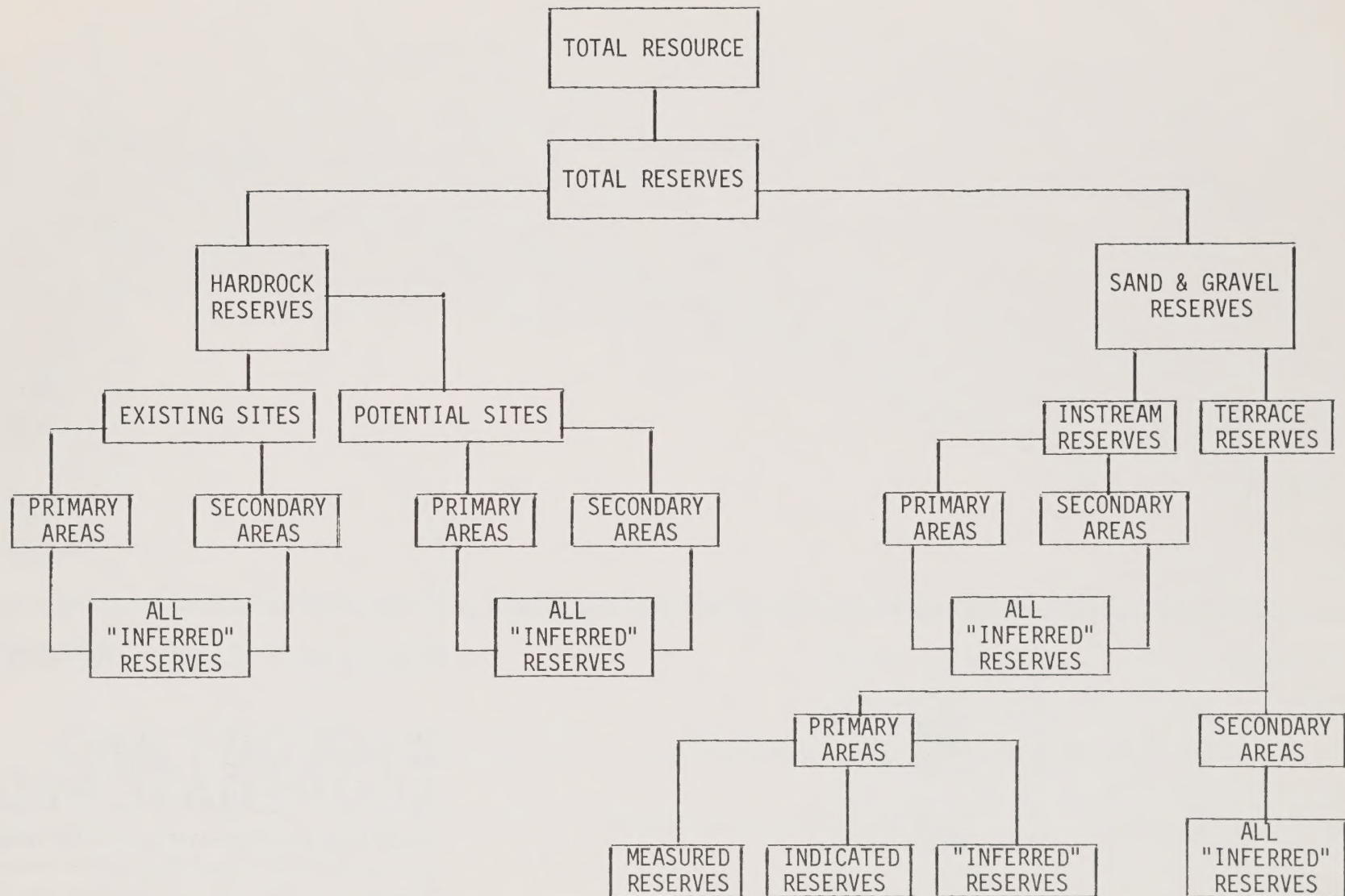


TABLE III-14

INSTREAM RESERVES

<u>Area</u>	<u>Acres</u>	X	Average Deposit <u>Thickness</u>	X	Usability <u>Factor</u>	X	Conversion ^O <u>Factor</u>	<u>Tons</u> [*]
I Middle Reach	637.6		50'		80%		2662	68,000,000
II Alexander Valley								
A. Primary Area	1,211.1		40'		90%		2662	116,000,000
B. Secondary Area	474.1		20'		90%		2662	23,000,000
III Dry Creek Valley	697.1		35'		90%		2662	<u>58,000,000</u>
Total								<u>265,000,000</u>

^OConversion factor for acre feet to tons is

$$\text{acre ft.} \times \frac{43,560 \text{ (sq.ft./acre)} \times 1.65 \text{ tons/cu.yd.}}{27 \text{ cubic feet/cubic yard}} = \text{tons}$$

^{*}Rounded to nearest million

	Area	<u>Acres</u>	X	Average Deposit <u>Thickness</u>	X	Usability <u>Factor</u>	X	Conversion ^O <u>Factor</u>	* <u>Tons</u>
I	Middle Reach								
A.	Primary Area								
	Measured Reserves	381.9		60'		90%		2662	55,000,000
	Indicated Reserves	1,042.5		60'		90%		2662	149,000,000
	Inferred Reserves	184.7		60'		90%		2662	26,000,000
B.	Secondary Area								
	Inferred Reserves	1,865.5		30'		75%		2662	111,000,000
	Total								341,000,000
II	Alexander Valley								
A.	Primary Area								
	Inferred Reserves	4,307.7		40'		85%		2662	388,000,000
B.	Secondary Area								
	Inferred Reserves	2,597.3		40'		65%		2662	179,000,000
	Total								567,000,000
III	Dry Creek Valley								
A.	Primary Area								
	Inferred Reserves	2,963.7		35'		85%		2662	234,000,000
B.	Secondary Area								
	Inferred Reserves	487.0		35'		65%		2662	29,000,000
	Total								263,000,000
^O Conversion factor for acre feet to tons is									
acre ft. X $\frac{43,560 \text{ (sq.ft./acre)} \times 1.65 \text{ tons/cu.yd.}}{27 \text{ cubic feet/cubic yard}}$ = tons									
* Rounded to nearest million									
	Total Terrace Reserves								1,171,000,000
	Setback and pit-slope adjustment (9%)								105,000,000
	Remainder:								1,066,000,000

TABLE III-16

HARDROCK RESERVESEXISTING QUARRIES

<u>Operation</u>	<u>Inferred Reserves (cu. yds.)</u>	<u>Remarks</u>
<u>Borrow Pits:</u>		
1. Arfsten	300,000	
2. Bohan & Canelis	644,000	
3. Chenoweth	403,000	
4. Ghilotti Brothers	1,730,000	
5. Graham	50,000	
6. Green Valley	4,000,000	To ridge line
7. Hagemann	12,600,000	
8. Passalacqua	197,000	Knoll only
9. Spaletta	1,922,000	
10. Stage Gulch	--	
11. Transcentury	2,535,000	
<u>Quarries:</u>		
12. Bloomfield	15,645,000	
13. Blue Rock	2,200,000	
14. Brooks	323,000	
15. Canyon	7,788,000	
16. Cinnabar	500,000	Tailings only
17. Inman	1,500,000	
18. Mark West	12,716,000	
19. Nun's Canyon	400,000	Northeast corner only

20. Quarry Products, Inc.	7,000,000 tons--QPI estimate	
21. Sonoma Rock	3,685,000	Includes buffer from Highway 121
22. Stony Point	746,000	
23. Trinity	6,400	Tailings only
24. Zamaroni	7,903,000	

3. Availability of access

4. Proximity of incompatible land uses

Samples of rock from a number of the visited sites were then tested for R-value, a test which gives a good indication of the overall hardness of the rock material and its potential application for construction use. It was found that the potential sites and some existing sites had rock of much better quality (R-value) than many of the presently unreliable quarry sites. Results of the survey, reconnaissance and testing are included in three technical reports submitted by the consulting team on file at the Planning Division. The study concluded that,

... "considering the distribution of geologic units within the County, that Sonoma County probably does have large reserves of hardrock aggregate. Therefore, it would appear that other factors besides geology must be used to determine the locations for future quarries."

The reserves for each of the terrace, instream, and hardrock sources have been estimated and are mapped on accompanying pages. Estimates according to the reserves categories on Table III-13 are found in Table III-18.

Existing quarry sites are mapped in Section VI.-C. Potential sites are mapped in the technical report entitled, "Potential Hardrock Quarry Site, Sonoma County, California" submitted by the geology team.

In conclusion, the projected 50-year demand of 165 million tons can be met by any of the three sources or a combination of two or more sources. In fact, the estimated 265 million tons of in-stream reserves, 1,066,000,000 tons of terrace reserves, or 1,075,800,000 tons of hardrock reserves will each meet aggregate demand well beyond 50 years.

TABLE III-17

HARDROCK RESERVESPOTENTIAL SITES

	<u>Million Tons</u>	<u>Remarks</u>
1. Buzzard Peak	30.0	
2. Champlin Creek	0.5	
3. Warm Springs Road	4.0	Interbedded with tuff
4. Felder Road	0.5	Minor tuff
5. Calabazas Creek	1.0	Interbedded with tuff
6. Nelligan Road	1.0	
7. Cavedale/Goldstein Roads	100.0	Interbedded with tuff
8. Schocken Hill	1.0	Dormant quarries
9. Lovall Valley Road	1.0	
10. Norrbom I	3.1	Dormant quarries

11. Norrbom II	10.0	Some tuff
12. Fairville	0.1	Interbedded with tuff
13. Highway 121	15.0	Thick overburden
14. Wildcat Mountain I)	11.0	Two deposits near road only
15. Wildcat Mountain II)		
16. Kawana Springs Road	100.0	Some felsite
17. Beebe Ranch	0.8	Abundant tuff
18. Rodgers Creek	10.0	
19. Highway 121 North	2.0	
20. Sonoma Mountain) Road I)	40.0	
21. Sonoma Mountain) Road II)		
22. Lynch Road)	0.1	
23. Hardin Lane)		
24. Western Avenue	1.0	
25. Dutch Bill Creek	10.0	
26. Roblar Road	100.0	Interbedded with Merced
27. Walker Road	10.0	Chert blocks
28. Alpine Road	5.0	Interbedded with tuff
29. Chalk Hill Road	0.2	
30. Leslie Road	--	
31. Van Buren Creek	100.0	
32. Porter Creek Road	100.0	Thick overburden
33. English Hill	--	
34. Bailhache Avenue	100.0	
35. Pine Flat Road	100.0+	
36. Gird Creek Road	100.0	

TABLE III-18

AGGREGATE RESERVE ESTIMATES(In million tons)

Total Reserves*			2,406.8
Sand and Gravel			1,331
Instream (All "Inferred")			265
Primary		242	
Secondary		23	
Terrace			1,066
Primary		776	
Measured	50		
Indicated	136		
Inferred	590		
Secondary (All "Inferred")		290	
Hardrock			1,075.8
Existing Sites			135
Primary		34.5	
Measured	7		
Inferred	27.5		
Secondary (All "Inferred")		100.5	
Potential Sites (All "Inferred")			940.8
Primary		698.4	
Secondary		242.4	

* For methodology and assumptions, see Appendix E.

SUBSTITUTE MATERIALS AND OTHER SOURCES

For most construction applications, rock products are required basic materials. For some uses, however, alternative materials exist which could, in the future, contribute to an overall reduction in the demand for rock. These alternatives include:

- 1) The use of pressure-treated wood for housing foundations.
- 2) Filter fabrics which can replace subbase and fill aggregates used under parking lots, roads, commercial and industrial facilities, etc.
- 3) The use of excavated native materials for backfilling utility trenches and subsurface drains.
- 4) The use of lime-treated subgrade as a substitute for base and subbase aggregates in road and highway construction.

In addition to the above-mentioned substitutes are a number of construction materials which normally compete with rock for use in construction, including brick, tile, plastics and metals.

Pressure-Treated Wood Foundations

An alternative exists to the present use of rock for home foundations. Pressure-treated wood can successfully be used for foundations as a substitute for the usual concrete slab. The pressure treating protects the wood from decay and pest damage. The use of wood foundations would lead to the increased use of the timber resource and reduced use of aggregate.

Filter Fabrics

Various fabric materials have been used in the con-

struction of roads, parking lots, railroad beds, and other facilities that require a stable foundation. The fabric is placed between the subsoil layer and the aggregate base, preventing the loss of aggregates into the subsoil during compaction and use. Aggregate requirements are further reduced by the fact that uncompactible subsoils need not be replaced by compactible fill materials. Filter fabric can also be used in subsurface drains, reducing both the quantity of aggregate required within the drain and allowing the use of a coarser gradation.

Native Backfill Materials

During trench excavation for subsurface drains and utility lines, imported aggregates are often used as pipe bedding and backfill. An alternative material which can be used for backfill is the originally excavated native subsoil itself. The excavated material, however, must be compactible and relatively free from excessive fines. The use of these native materials, where possible, often offers a substantial savings in the cost of trenching operations and is a practice recommended by the Sonoma County Public Works Department.

Lime-Treated Subgrade

Road construction involves the placement of successive layers of subbase and base aggregates overlain by the surface course. Occasionally, depending on local soil conditions, a lime treatment can be applied to the native subsoils enabling them to perform as a subbase. In such cases, no imported subbase aggregates would be required. Generally, heavy clays like those which are found in the Rohnert Park, Cotati, and Petaluma areas can be successfully treated and used as subbase. Lime-treated subgrades have occasionally replaced base aggregates for subdivision and parking lot projects, although this practice is seldom employed at present. The use of lime-treated subgrade, of course, is dependent on

the availability of lime. In the past, this availability has fluctuated rapidly, forcing contractors to rely more heavily on imported subbases.

OTHER SOURCES OF AGGREGATE MATERIALS

As mentioned before, the three major sources of aggregate materials in Sonoma County are the hardrock quarry, the alluvial terrace, and instream gravels. In addition to these, however, are a number of other sources which can, and occasionally do, supply aggregate materials for particular uses. Among these alternative sources are:

- 1) Coastal beach sands
- 2) Bay and Delta sands
- 3) Recycled concrete
- 4) Various tailings from industrial and other mining operations
- 5) Other aggregate materials imported from beyond the regional market area

Coastal Beach Sands

Sands are occasionally imported from nearby coastal beaches as an additive for blending with coarser materials in the production of concrete aggregates. Particle gradation specifications often allow only a small portion of the beach sands to be used, however, due to their uniformity in size. Issues related to beach sands extraction include the preservation of dune grasses and other habitats, maintenance of beach replenishment, potential impacts on coastal recreation opportunities, and scenic and visual resources. An important consideration in the use of these materials is the haul distance required to deliver them to inland processing facilities and the resultant cost increase in the f.o.b. price of concrete aggregates.

Bay and Delta Sands

Several San Francisco Bay Area mining operations are currently involved in dredging the Bay and Delta regions for sand to be used in various construction applications. Although no Sonoma County firms are involved directly, one local quarry operation and a building materials supply company now import dredged sand from a Delta source near Antioch.

Studies conducted by the Department of Water Resources (1955), U. S. Army Corps of Engineers (1963), and the California Division of Mines and Geology (1967) have estimated the quantity of sand available in the San Francisco Bay and Delta region to be approximately 271 million cubic yards (exclusive of the ocean sands west of the Golden Gate Bridge). Another estimate by the Bay Conservation and Development Commission (BCDC) placed the amount at 480 million tons from Rio Vista to the Golden Gate Bridge. No comprehensive data are available on the rates of replenishment, although an estimate of 1500 cubic yards/year was made for the Point Knox School south of Angel Island.

Particle sizes vary with the location of the dredging operations. The sands are mined from the underwater deposits with a suction dredge, loaded onto a barge, and transported either to processing facilities or to the onshore buyer. Dredged sands sold in Sonoma County are barged up the Petaluma River to loading facilities in Petaluma. The sand can be sold for use in Portland Cement concrete or blending sand for asphalt concrete.

Again, transportation of the sands is the most expensive portion of the mining operation. However, haulage costs by barge (1-2¢ per ton/mile) are significantly lower than by truck (10¢ per ton/mile). Other considerations in the use of Bay and Delta sands in Sonoma County markets include the additional cost of unloading and delivering the sand to areas inaccessible by water, the limited particle size

variation available, and the extent of processing required to remove organic and other deleterious substances from the usable sand.

At issue in the mining of Bay and Delta sands are potential environmental impacts on marine organisms, water quality, navigation, and the potential for depletion of a natural resource at a more rapid rate than its replenishment. The State Lands Commission, the BCDC, and the U. S. Army Corps of Engineers have the responsibility of overseeing the dredging operations. Other agencies involved include the Regional Water Quality Control Board, the U. S. Coast Guard, and the Department of Fish and Game. A recent proposal to dredge the shoals between San Francisco and Marin County resulted in the issuance of a Negative Declaration provided particular mitigation measures were designed into the project.

Recycled Concrete

A number of mining operations in Sonoma County are turning to recycled concrete as an alternative source of supply for some uses. The Petaluma Quarry operates a "recycling center" for used rock materials, and the Stony Point Quarry reprocesses concrete rubble for subbase and fill purposes. As the cost of "virgin" rock resources rises, the use of recycled rock will likely increase.

Some obstacles exist, however, to the use of recycled materials. The transportation and handling of the rock adds to its cost. The location of the Stony Point operation near the Central Refuse Disposal site enables it to "intercept" rock bound for disposal and thereby avoid this additional expense. Processing of the rubble involves several steps, including the removal of organic substances, removal of reinforcing bar, wire, etc., and reducing the large blocks to a size which can be handled by available crushing equipment.

Tailings from Industrial and Other Mining Operations

The U. S. Bureau of Mines, in its Mineral Commodity Profile Series (MCP-17: Stone, 1978) mentions that iron-blast-furnace slag is a material competitive with rock products for many specifications. However, to date, the lack of these metal processing wastes in Sonoma County renders their use unlikely. Lightweight aggregates, such as cinder, pumice or processed shale and limestone, also compete somewhat with other rock products.

Mine tailings from the former mercury mines in Sonoma County are a proven source of rock products. The Cinnabar Rock Quarry in Guerneville is presently processing the tailings of the Mt. Jackson Mine for use in trench backfill and road and subdivision construction. Other former mercury mines have been located in the Pine Flat area east of Geyserville, including the Socrates, Eureka and Culver Baer mines. Chromite, manganese and magnesite are other minerals which have been mined in past years.

Other Aggregate Materials Imported from Beyond Sonoma County's Borders

Specialty aggregate products are occasionally imported to Sonoma County due to particular specifications required by some users. In these cases, the buyers are willing to pay the added expense of importation for a material with one or more particular quality. "Olympia Felton Sand" from the Monterey area is especially desirable for some uses due to its hardness, gradation, and aesthetic characteristics. Various decorative rocks are also transported into and out of Sonoma County over long distances due to varying specifications.

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IV. DETAILED ANALYSIS OF IMPACTS OF MINING ALTERNATIVE SOURCES

The following section presents charts, tables, and written descriptions of the significant adverse environmental effects of extraction operations in Sonoma County. The assessment includes site preparation, extraction processing, and transportation of aggregate materials from each of the hard rock, alluvial terrace, and instream sources in Sonoma County. The impacts are discussed as a whole for each type of source, followed by a description of particular impacts generated by individual operations.

ALL HARDROCK OPERATIONS

The accompanying table lists the potential impacts which may occur as a result of hard rock quarry mining operations. The list was derived from the standard Initial Study checklist used for environmental review by the Planning Division. The impacts have been divided into five broad categories in order to simplify the descriptions; earth, air, water, biological, and cultural impacts.

Earth

Quarry operations result in several potential impacts on geology and soils. Most of these are onsite impacts which are mitigable through various standards for operation and for reclamation. The occurrence of unstable working slopes can be mitigated by the creation of benches at particular intervals on the slope and replanting of vegetation at the conclusion of operations. Topsoil compaction or removal during site preparation can be mitigated by storage and subsequent replacement. The potential for an offsite increase in soil erosion can be mitigated during operations by the construction of retarding basins, settling ponds, etc. Increases in erosion potential onsite, however, can only be mitigated by reclamation standards for the reestablishment of vege-

tation on the remaining slopes. The most significant earth impact is the long-term irreversible change in local topography resulting from the removal of earth materials. Reclamation standards for final slopes and replanting will only partially mitigate this impact.

Air

Impacts of quarry operations on air resources are unavoidable in that only partial mitigation exists. Furthermore, these impacts occur both onsite and offsite. Air quality impacts are associated with all phases of a quarry operation, but are most significant during the processing and transportation phases. Dust is generated from both processing operations and truck traffic. Mitigation measures available during the operation phase include the spraying of oil or water over haul routes and drop piles and coverage of crushers with baghouses or sheds. Emissions from truck engines, in addition to being only partially mitigable through compliance with federal emission standards (EPA), are cumulative with other mining operations when using the same haul routes.

Water

The water-related impacts of hard rock mining are threefold. Potential increases in the amounts and rate of surface water runoff on and offsite are mitigable with the application of operation and/or reclamation standards. Available mitigation measures include the construction of retarding basins and/or settling ponds and revegetation programs subsequent to the operation. The change in drainage pattern, however, is only partially mitigable. Diversion dikes, ditches, etc., can be applied so that the offsite impacts are mitigated. However, the onsite drainage alterations are unavoidable.

Biological

Quarry operations have the potential to affect plant and animal life both on and offsite. As far as is presently known, though, no existing

ALL HARDROCK QUARRY OPERATIONS

	Initial Study Reference	ADVERSE IMPACTS	MITIGATION			Unavoidable	Irreversible	Long Term	Onsite	Offsite	Cumulative
			Operation Standards	Reclamation Standards	Monitor						
EARTH:	2A	UNSTABLE WORKING SLOPES	X	X					X		
	B	DISRUPTION OF TOPSOIL	X	X					X		
	C	CHANGE IN TOPOGRAPHY		X		X	X	X	X		
	E	INCREASE IN SOIL EROSION	X	X					X	X	
AIR:	3A1	EMISSIONS FROM ENGINES	X			X			X	X	X
	A2	DUST FROM PROCESSING OPERATIONS	X			X			X	X	
	A3	DUST FROM TRUCK TRAFFIC	X			X			X	X	
WATER:	4C	CHANGE IN DRAINAGE PATTERN	X	X		X	X	X	X	X	
	D	INCREASE IN AMOUNT OF SURFACE WATER RUNOFF	X	X					X	X	
	D	INCREASE IN RATE OF SURFACE WATER RUNOFF	X	X					X	X	
BIOLOG- ICAL:	5ABC	REMOVAL OF EXISTING VEGETATION	X	X		X			X		
	6D	POTENTIAL BARRIER TO ANIMAL MOVEMENT	X	X		X			X	X	
	E	POTENTIAL DETERIORATION OF FISH OR WILDLIFE HABITAT	X	X		X			X	X	
CUL- TURAL:	7AB	INCREASED NOISE LEVEL (DAY & NIGHT)	X			X			X	X	
	9A	INCREASED USE OF NATURAL RESOURCE			X	X	X	X			X
	B	DEPLETION OF NON-RENEWABLE RESOURCE			X	X	X	X			X
	13A	ADDITIONAL TRUCK TRAFFIC			X	X				X	X
	F	POTENTIAL TRAFFIC HAZARD	X			X				X	
	H	ADDITIONAL ROAD MAINTENANCE REQUIRED	X			X				X	
	14B	ADD. POLICE PROTECTION DUE TO VANDALISM POTENTIAL	X			X			X		
	15A	INCREASED DEMAND FOR ENERGY			X	X	X				X
	17A	POTENTIAL SAFETY HAZARD: SLOPES, EQUIPMENT	X	X					X	X	
	18	VISUAL/SCENIC DETERIORATION	X	X		X			X	X	
	20	ARCHAEOLOGICAL/HISTORIC RESOURCES LOST	X		X				X		

OTHER IMPACTS:

OTHER IMPACTS:	MITIGATION			NO MITIGATION					
	Operation Standards	Reclamation Standards	Monitor	Unavoidable	Irreversible	Long Term	Onsite	Offsite	Cumulative
A. EARTH: None									
B. AIR: None									
C. WATER:									
1. Groundwater Use			X	X			X	X	
2. Reduced Aquifer Recharge	X	X					X	X	
3. Deteriorate Water Quality	X	X					X	X	
D. BIOLOGICAL: None									
E. CULTURAL:									
1. Loss of Quality of Recreation Opportunity	X	X					X	X	
2. Loss of Grazing Land		X		X		X	X		X
3. Blasting Operation Impacts	X		X	X			X	X	

quarries presently threaten the habitat or existence of any rare or endangered species (Sonoma County Planning Division, Environmental Data File). However, potential impacts, including the removal of existing vegetation, the creation of barriers to animal movement, and the deterioration of fish or wildlife habitat, are unavoidable. Available mitigation measures include operation standards for setbacks from sensitive areas, riparian corridors, streams, unique biotic communities, etc., and reclamation standards for the reestablishment of impacted habitats. However, these measures do not completely mitigate the unavoidable impacts associated with vegetation removal.

Cultural

Several cultural impacts result from quarry operations. They range from those onsite impacts for which mitigation measures are available to some which are long-term, cumulative, and irreversible.

Quarry mining involves the use of a natural, non-renewable resource. The increased use and potential depletion of the resource is dependent on the demand for aggregate materials. Since there are few practical alternatives to the use of aggregate and no mitigation measures are available through either operation or reclamation standards, only comprehensive monitoring of the use of the resource Countywide will determine at what rate supplies are being depleted. These impacts are irreversible, however, and cumulative among all hard rock operations. The increased demand for energy used in processing and transporting operations is also irreversible and cumulative. Again, monitoring is the only mitigation measure available to determine the Countywide consumption of energy required to obtain aggregate supplies. (See Topical Issues: Energy.)

Several impacts on the cultural environment are only partially mitigable and are therefore, to a

degree, unavoidable. First, mining hard rock potentially increases day and night noise levels, both on and offsite. Partial mitigation is available through operation standards for hours of operation (night noise), berms, and property line or zone boundary setbacks. Another unavoidable impact is the generation of additional truck traffic offsite. Truck traffic impacts are also cumulative when haul routes are shared with other quarries. Countywide monitoring of levels to determine the overall truck use generated by the aggregate industry is the only mitigation measure available.

Other impacts which are unavoidable include the potential traffic hazard, additional road maintenance and the potential for deterioration of visual and scenic quality. Available traffic hazard mitigation consists of a requirement for the installation of traffic management facilities. Road maintenance can be required of the operation as a mitigation measure for impacts on road durability. Visual and scenic deterioration can be partially mitigated by operation standards for berm construction and/or vegetative screening and by reclamation standards for further revegetation. The potential for greater demand for police protection due to increased vandalism can only be partially mitigated with fencing and screening to reduce accessibility.

Finally, cultural impacts generated by quarry operations for which mitigation measures are available include those related to safety hazards and archaeological resources. The potential safety hazard resulting from steep slopes and onsite equipment can be mitigated by operation standards for fencing and by reclamation standards for final reclaimed slopes and equipment removal. The potential loss of archaeological/historic resources can be mitigated by a pre-operation site reconnaissance and subsequent mitigation.

INDIVIDUAL HARDROCK OPERATIONS

The following section outlines (1) particular impacts

which are potentially more severe due to surrounding uses or designations (see Table IIA-1&2) and (2) other impacts which may result solely from particular operations (see Table IV-2).

Mitigation measures for impacts listed on Table IV-2 are described in the previous section. In general, these same measures will mitigate the additional severity of the impacts. However, stronger operation and reclamation standards may be recommended in order for particular operations to properly mitigate the potential effects.

A description of the mitigation measures available for the additional impacts listed on Table IV-2 follows.

Measures available to mitigate the potential impacts related to a reduction in aquifer recharge, the deterioration of water quality and the reduction in quality of recreational opportunity include both reclamation and operation standards. Potential impacts related to groundwater usage, the loss of extensive agricultural lands, and blasting operations are each unavoidable to a certain extent. The potential for overdrafting groundwater supplies (4 borrow pits and 5 quarries) can be determined by continual monitoring of water table levels. The loss of grazing land is partially mitigable by reclamation standards which provide final slopes and replanting that can return the land to grazing use. Additional water supplies could be obtained with the construction of water storage ponds to capture and hold storm runoff.

Generally, a water requirement of at least 100 gallons per minute is required for washing aggregates for concrete use, but net water use can be reduced by recharging desilted water into the aquifer or recycling it back through the processing operation.

Operation standards which will mitigate potential impacts on aquifer recharge areas include setbacks and erosion control measures. Reclamation standards include the revegetation of disturbed areas. Po-

tential water quality impacts can be mitigated by standards requiring retarding basin and/or other siltation control measures. Impacts on recreational uses in the vicinity of quarry operations can be mitigated by visual screening and setbacks from heavy use areas.

Individual Borrow Pits

1. Arfsten Sand Pit:

Offsite erosion, noise, and truck traffic impacts are more significant at this site due to the sloping terrain and surrounding commercial and residential uses.

2. Bohan and Canelis:

Proximity to Austin Creek and recreation uses intensifies the potential for visual and water quality impacts. In addition, a potential exists for a reduction in the quality of recreational opportunity.

3. Chenoweth:

The water quality impacts may be more severe due to the intermittent stream immediately adjacent to the site.

4. Ghilotti Brothers:

Quarrying of this site precludes its use for grazing purposes. Secondly, the potential visual impacts are more severe due to the scenic corridor designation, although measures presently being undertaken to screen the quarry from view have mitigated the visual impact. Finally, the site is used for equipment storage, which may increase off-site truck traffic hazards.

5. Graham:

Potential impacts related to public safety, road maintenance and traffic hazard are all increased. Occasional blasting increases the potential for noise and structural impacts.

6. Green Valley:

Visual and truck traffic impacts are potentially more severe. Additional impacts may result from blasting, fire hazard, and nearby recreational uses. The potential exists for this quarry to produce an aggregate product that requires washing. If so, local groundwater supplies may be affected.

7. Hagemann:

In addition to the increased potential visual and traffic hazard (bikeways) impacts, this operation could impact groundwater supplies and reduce available adjacent grazing lands.

8. Passalaqua:

Additional impacts are similar to those of the Hagemann site (No. 7 above) with the exception of the potential for increased traffic hazard.

9. Spaletta:

Additional impacts similar to those of the Passalaqua pit (No. 8 above).

10. Stage Gulch:

The potential visual impacts are increased by the scenic area designation. Truck traffic impacts are cumulative with the adjacent refuse disposal operation. The potential exists for further loss of grazing lands.

11. Transcentury:

Potential impacts (noise, etc.) on the subdivision located immediately adjacent to the site are increased. Some additional grazing land may also be affected.

Individual Quarries

1. Bloomfield:

The quarry is mining lands which have grazing potential, thereby precluding that use. In addition, the rock is sufficiently hard in places to increase the potential impacts resulting from blasting and groundwater usage.

2. Blue Rock:

Visual, truck traffic, and truck traffic hazard impacts are potentially more severe due to scenic and bikeway designations and are cumulative with the adjacent quarry. Occasional blasting operations increase the potential noise and structural impacts.

3. Brooks:

Blasting operations potentially increase the noise and structural impacts at this site, too. In addition, road durability impacts may be increased due to the occasional necessity for hauls during winter rains. Traffic hazard and truck impacts are potentially more severe due to residential development along Brooks Road.

4. Canyon Rock:

Visual, truck traffic, and traffic hazard impacts are potentially increased by scenic and bikeway designations and are cumulative with the adjacent Blue Rock Quarry. Blasting impacts may also occur. The proximity of the

processing operation to the aquifer and riparian corridor associated with Green Valley Creek increases potential impacts on water quality, groundwater recharge, and riparian vegetation and habitat.

5. Cinnabar:

The neighboring contractor's yard generates truck traffic which is cumulative with that from the quarry operation. Potential effects on aquifer recharge and groundwater supply exist at this site. The potential also exists for water quality degradation due to mercury contamination from the cinnabar tailings. Test results of the tailings indicate, however, that mercury levels are below current federal standards. In addition, the tailings have been in place for several years, during which time the small amounts coating the rock after the mercury operation have most likely been leached from the stockpile.

6. Inman:

The potential exists for siltation in Wallace Creek adjacent to the quarry operation. In addition, occasional blasting operations and residences bordering the access routes have the potential to intensify the truck traffic and noise impacts.

7. Mark West:

Potential visual impacts are increased by the scenic corridor designation of Calistoga and Porter Creek Roads. Furthermore, residential development along access routes increases the potential truck traffic impacts. The potential use of groundwater and blasting in conjunction with this operation may give rise to impacts related to noise, structural damage, or over-drafting of groundwater.

8. Nun's Canyon:

The rock deposit at Nun's Canyon is sufficiently hard to necessitate occasional blasting. However, the existing use permit precludes it. Visual impacts are more severe due to scenic area and corridor designations. Truck traffic and traffic hazard impacts are cumulative with the nearby Trinity Quarry. Potential water quality impacts may result due to the proximity of an intermittent stream downslope from the processing area.

9. Quarry Products, Inc.:

Blasting operations are occasionally required. Air quality impacts are more significant in the Petaluma basin (designated an Air Quality Study Area by the Bay Area Air Pollution Control District in 1973) and cumulative with surrounding industrial uses. Onsite processing includes an asphalt batching plant which contributes additional engine emissions to the air. The quarry presently uses groundwater for its operations. Visual impacts are intensified at this site due to its high visibility from a wide area and scenic area and corridor designations. Potential water quality impacts are more severe due to the site's proximity to the Petaluma River.

10. Sonoma Rock, Inc.:

Potential impacts from occasional blasting and groundwater usage may occur at this site. The adjacent intermittent stream results in the potential for siltation. Although the quarry operation is presently not visible from Highway 121, the same corridor designation for that route increases the importance of the potential visual impact.

11. Stony Point:

Potential visual impacts are increased due to the scenic area designation of this site. Continued use of surrounding grasslands for mining will preclude their use for grazing during the life of the operation.

12. Trinity:

Truck traffic and traffic hazard impacts are cumulative with the adjacent Nun's Canyon Quarry. Potential visual impacts are severe, especially along the scenic corridor of Trinity Road.

13. Zamaroni:

The traffic hazard impacts are more severe due to the bikeway designation of Petaluma Hill Road. The visual impacts resulting from the operation are more severe due to the scenic area designation and the contrasting color or the exposed rock set against the backdrop of Taylor Mountain. Some potential grazing land is lost by the continued expansion of the operation.

ALL TERRACE OPERATIONS (See Table IV-3.)

Earth

Impacts on land forms resulting from terrace mining operations are mostly unavoidable. They include the onsite impacts of removal of subsurface alluvial materials, the disruption and compaction of topsoil, changes in topography, and the removal of prime soils from agricultural production. Mitigable impacts include an increase in onsite soil erosion potential and possible changes in the course of the river both on and offsite.

Mining of the terraces involves an irreversible change in topography with the removal of the alluvial sand and gravel to depths of seventy-five feet in some locations. These pits generally extend over large acreages, penetrate the groundwater basin, and have side slopes of about 1:1. Only partial mitigation is available with a reclamation standard requiring that some of the removed materials be returned to the excavations. However, this standard may generate its own impacts on groundwater as discussed later in this section.

In order to remove the underlying alluvium, significant amounts of topsoil must be removed. Other soils are compacted by the use of heavy equipment and trucks associated with processing and hauling operations. Operation standards for topsoil salvage and reclamation standards for its replacement are available as partial mitigation measures.

The other unavoidable impact resulting from terrace mining in the valleys is the removal of prime soils from agricultural production. This is a long-term, irreversible impact and cumulative among all operations. Soil types of the Yolo-Cortina-Pleasanton Association predominant on the valley floors are coincident with terrace reserves. Although Cortina soils are classified in Capability Unit IV by the Soil Conservation Service and have a Storie Index Rating of Grade IV (see Topical Issues: Agriculture), the nature of their limitation for crop production is such that they must be considered as prime soils. Essentially, the rapid loss of water during the dry season is compensated by the high availability of water pumped from areas adjacent to the river.

Only partial mitigation is available for this impact. Alluvial fines remaining from processing operations can be returned to the pits, recovered with topsoil, and planted. Since approximately 90% of the extracted materials remain in the aggregate products sold by terrace operations, the waste muds account for only about 10%. As a result, only 10% of the prime land

TABLE IV-3

ALL TERRACE OPERATIONS

	Initial Study Reference	ADVERSE IMPACTS	MITIGATION								
			Operation Standards	Reclamation Standards	Monitor	Unavoidable	Irreversible	Long Term	Onsite	Offsite	Cumulative
EARTH:	2A	REMOVAL OF ALLUVIAL SUBSTRUCTURE		X		X	X	X	X		
	2B	DISRUPTION OF TOPSOIL	X	X		X			X		
	2C	CHANGE IN TOPOGRAPHY				X	X	X			
	2D	REMOVAL OF PRIME SOILS FROM PRODUCTION	X	X		X	X	X	X		X
	2E	INCREASE IN SOIL EROSION POTENTIAL	X	X					X		
	2G	POTENTIAL MODIFICATION OF RIVER'S COURSE	X	X	X				X	X	X
AIR:	3A1	ENGINE EMISSIONS	X			X			X	X	X
	3A2	DUST FROM PROCESSING OPERATIONS	X			X			X	X	
	3A3	DUST FROM TRUCKS	X			X			X	X	
WATER:	4A	POTENTIAL CHANGE IN WATER MOVEMENT COURSE OR DIRECTION	X	X	X	X			X	X	X
	4B	CHANGE IN ABSORPTION RATE OF AQUIFER	X	X		X	X	X	X	X	X
	4C	CHANGE IN DRAINAGE PATTERN	X	X	X	X			X	X	X
	4E	CHANGE IN FLOOD FLOW	X	X	X	X	X	X	X	X	X
	4G	DISCHARGE OF SILTS INTO SURFACE WATERS	X	X						X	X
	4I	REDUCTION IN GROUNDWATER SUPPLY			X	X	X	X	X	X	X
	4J	CHANGE IN GROUNDWATER QUALITY	X	X	X	X			X	X	X

TABLE IV-3
(Continued)ALL TERRACE OPERATIONS

	Initial Study Reference	<u>ADVERSE IMPACTS</u>	MITIGATION								
			Operation Standards	Reclamation Standards	Monitor	Unavoidable	Irreversible	Long Term	Onsite	Offsite	Cumulative
BIOLOG- ICAL:	5A	VEGETATION REMOVAL	X	X		X			X		
	5E	REDUCTION IN UNIQUE BIOTIC HABITAT (RIPARIAN)	X	X	X						X
	5G	REDUCTION IN INTENSIVE AGRICULTURAL ACREAGE	X	X	X	X	X	X	X		X
	6A	REDUCTION IN UNIQUE WILDLIFE HABITAT (RIPARIAN)	X	X	X				X		X
	6D	BARRIER TO ANIMAL MOVEMENT	X	X		X			X		
	6E	DETERIORATION EXISTING FISH OR WILDLIFE HABITAT	X	X	X						
CUL- TURAL:	7AB	INCREASED DAY AND NIGHT NOISE LEVELS	X		X	X			X	X	X
	9A	INCREASED USE OF NATURAL RESOURCE			X	X	X	X			X
	9B	DEPLETION OF NON-RENEWABLE NATURAL RESOURCE			X	X	X	X			X
	13A	ADDITIONAL TRUCK TRAFFIC			X	X			X	X	X
	13F	POTENTIAL TRAFFIC HAZARD	X			X				X	X
	13H	ADDITIONAL ROAD MAINTENANCE REQUIRED	X			X				X	X
	14B	ADD. POLICE PROTECTION REQUIRED DUE TO VANDALISM POTENTIAL	X	X					X		
	15	INCREASED DEMAND FOR ENERGY			X	X	X	X			X
	17A	CREATION OF A POTENTIAL SAFETY HAZARD	X	X					X		
	18B	LOSS OF VISUAL/AESTHETIC QUALITY	X	X		X			X	X	
	19	POTENTIAL LOSS OF QUALITY OF RECREATIONAL OPPORTUNITY	X	X					X	X	
	20A	ALTERATION OF ARCHAEOLOGICAL/HISTORICAL SITE	X						X		

excavated can be returned through direct reclamation. In addition, present efforts to grow crops on reclaimed farmland have not been in progress long enough to determine whether or not they will be successful. An operational standard that would reduce the impact on farmlands would be the relocation of processing facilities away from the valley floors.

Increases in soil erosion potential and changes in the river's course can result from terrace extraction. During extraction, the perimeters of the pits are left bare, resulting in the erosion of pit slope soils into the excavation. Removal of riparian vegetation can also cause soils to wash into the river or pit during wet months. Topsoil storage piles are also a potential source of erodible soils. Changes in the river's course may result if excavations occur near the river itself. The possibility also exists that several excavations aligned near the river might combine to significantly modify the river channel's course through the valley.

Measures are available to completely mitigate these impacts. Soil erosion potential can be reduced by operation and reclamation standards for final grade and revegetation of pit slopes, removal of riparian vegetation, and slope protection of topsoil storage piles. Mitigation measures available to prevent changes in the river's course include operational standards for setbacks from the river channel and the establishment and maintenance of a bank stabilization program. Reclamation mitigation includes the establishment of vegetative cover on bank works. Systematic monitoring of the river's course is also an available measure for determining the potential for future impacts.

Air

Impacts on air quality are unavoidable. Emissions from truck engines result from the hauling of aggregate products. Mitigation is limited to compliance with present federal standards for emission control.

Batch plant emissions can be partially mitigated with the use of scrubbers, etc. The other impacts on air quality result from dust generated by the processing and transportation phases. Processing operation dust is generated mainly by the crushing phase. As rock particles are broken by rapid compression, the dust particles are airborne. When conveyors drop screened gravels onto stockpiles, additional dust particles escape and become airborne at that point. Finally, fugitive dust is generated by loading and hauling vehicles in use on the site or along access roads. Due to less extensive crushing involved, relatively less dust is generated by gravel operations than by hardrock operations and, as a result, similar mitigation measures are more effective in reducing fugitive dust. Available mitigation of dust impacts includes the installment of sheds or baghouses over crushers and watering of drop piles and haul areas. Haul road paving is also an alternative. The increased usage of wet processing methods would also reduce dust impacts.

Water

Impacts on water resources and river hydrology are cumulative among all terrace operations and occur offsite as well as onsite. They include the irreversible impacts on aquifer recharge and groundwater transmissivity, alterations to flood flow, and reduction in groundwater supply. Other impacts include a potential change in the course or direction of water movement, change in drainage patterns, potential discharge of silts into surface waters of the river, and changes in groundwater quality.

Impacts on aquifer recharge can result from terrace extraction in several ways. First, alluvial gravels which constitute the aquifer itself are removed during the extraction process. Groundwater formerly stored within the deposit becomes free-standing water, and recharge to the mined area occurs by direct flow from surrounding lands, by subsurface flow from the adjacent aquifer, and di-

rectly from rainfall. The rate of recharge from all three is increased due to the lack of obstructing gravels. However, as silts and eroded soil from surrounding lands, pit slopes, and flood waters enter the pit and line its bottom and sides, recharge through and beneath the pit is slowed significantly. Subsurface flow through the basin, or groundwater transmissivity, is thereby affected. The cumulative excavations of several adjacent operations could result in the creation of a barrier to groundwater movement across the entire basin in narrow areas.

Thirdly, a reduction in aquifer recharge through the streambed can occur in a manner similar to instream operations. Soils and silt generated by the removal of riparian vegetation are eroded into the stream channel and deposited along its bed, building an impermeable barrier to downward flow into the basin.

Various mitigation measures are available for the impacts on aquifer recharge. However, they will not completely mitigate all impacts, and some mitigation measures can result in other hydrologic impacts. Soil erosion from pit slopes can be partially mitigated by a pit slope revegetation program begun as soon as the dredge is removed from a particular portion of the pit. The vegetation, when established, will also act as a filter, trap soil eroded from surrounding lands, and prevent much of its deposition into the pit. Standards limiting the removal of riparian vegetation and requiring desilting basins to control runoff from the processing site will mitigate the potential effects on streambed recharge. A more comprehensive measure would be a standard limiting the depth of extraction to a level above the water table. This measure, however, would result in an additional acreage requirement of from 3.5 to 5.5 times the present requirement as well as other impacts.

Onsite changes in drainage pattern, movement of flood waters, and the course of water movement are

unavoidable, since water which would normally flow across the flood plain is diverted into the excavation. Offsite changes, however, can be mitigated, with the exception of the irreversible change in flood flows on surrounding lands. Sediments are deposited by flood waters on lands surrounding the pits; the buildup may divert the flow elsewhere. Although flood elevations may be reduced locally due to the increased capacity of the pit to hold water, flows which originally moved directly into the pit may also be diverted elsewhere. The proximity of the pits to the river can result in the diversion of stream flow through the narrow strips of land separating them from the channel.

Mitigation measures available to reduce these impacts include the construction of various flood control and bank protection structures, diversion dikes and ditches which would protect the pit areas from stream flow. Another available measure is one which would require that all future terrace operations be located at a safe distance from the river. The fact that these impacts are cumulative among all of the terrace operations along the river requires that these measures be applied to individual operations but under the framework of a basinwide plan. Reclamation standards for replanting of denuded areas and maintenance of drainage and flood control structures would further mitigate these impacts.

The potential for the offsite discharge of silts into the river adjacent to the pits results from the removal of riparian vegetation and/or processing operations near stream channels. The riparian growth acts as a filter of soil-laden runoff from surrounding agricultural and mined lands. Its removal allows the runoff to enter the channel unfiltered and be deposited along the streambeds. Complete mitigation can be achieved, however, with standards limiting the removal of streamside vegetation and prohibiting the location of processing operations near streams.

Impacts of terrace extraction on groundwater supply and quality are also cumulative among all operations and occur onsite and offsite. The reduction in groundwater supply is irreversible. The increased water holding capacity of the pits resulting from the removal of sand and gravel draws flow from elsewhere in the aquifer, thereby lowering the elevation of the water table locally. This, however, is probably insignificant, given the estimated total storage of approximately 16 million acre feet in the Santa Rosa Basin (includes the Middle Reach and Dry Creek Valley). The second way in which supply is affected is through the increased evaporation of groundwater from its exposed surface in the pits. Estimates in the Middle Reach for annual evaporation from ponds and lakes is about 48 inches per year over the entire exposed area. The loss in supply to evaporation, then, is about four acre feet per acre mined.

Groundwater quality can be affected by extraction operations in the pit. Dredging stirs up sediments lying on the subsurface pit floor, suspending them and resulting in turbid water. This probably does not affect groundwater underlying lands adjacent to the operation, since sands present in the alluvial formation will act as a filter and trap the finer sediments. However, when sands are not present in artificial structures such as levees, the silts can migrate through them and affect offsite water quality as well.

Some mitigation measures are available for the potential impacts on groundwater. Supply could be protected by a requirement that extraction not penetrate the water table. However, this could again result in an additional terrace extraction acreage of 3.5 to 5.5 times the present requirements as well as other impacts. Groundwater quality offsite can be mitigated by standards requiring that suspended sediments be contained within the pits. Onsite impacts are unavoidable until operations are concluded.

Biological

Potential biological impacts resulting from terrace extraction operations are threefold. Removal of vegetation, reduction in unique biotic or wildlife habitat, the creation of barriers to animal movement, and the deterioration of fishery habitat are all impacts related to the loss of riparian vegetation. Secondly, fishery habitats are also degraded by the siltation of the streambed resulting from the disruption of topsoil and increases in soil erosion. The third, a reduction in acreage used for intensive crop production, has been considered under earth impacts.

Terrace pit extraction adversely affects both aquatic and terrestrial life when it results in damage or loss of riparian vegetation. The fishery habitat is deteriorated by increases in water temperature, removal of shelter or cover from predators, and reductions in the available food supply. Water temperatures, when shaded by streamside vegetation, were from 4° to 10° lower (depending on water depth and velocity) than temperatures in unshaded areas in Austin Creek (Hopkirk, 1979). Reduction in cover or shelter means that fish are more frequently exposed to predator birds which are common in the Russian River system. Finally, the loss of shaded habitat for insect population means that less food is available for the fish when streamside areas are denuded.

Terrestrial plants and animals are directly affected by terrace mining operations when riparian vegetation is removed. Destruction of the riparian habitat results in the loss of shelter or cover, reduction in food supply, reduction in the diversity of habitats, and microclimatic changes.

Fishery habitat is also affected by the siltation which can result from terrace extraction. Disruption of topsoil, removal of riparian vegetation, leaching of sediment detention basins, increased erosion, and/or direct exchange of flow between the pits and the channel will cause an excessive amount of fine sediments

to be released to the streambed. When this happens, the fishery resource may be affected in the following ways:

- a. The suffocation of eggs and fry either directly or when stream flow through nesting access is impeded.
- b. Prevention of the emergence of the fry from the nest.
- c. The direct clogging of the gills.
- d. The clogging of the open crevices between gravels, reducing cover for aquatic organisms.
- e. The clogging of gravels and other substrate types so that spawning cannot occur.
- f. A change in the relative composition (gradation) of the substrate, reducing spawning potential.
- g. Reduction in the productivity of the substrate for aquatic insects used for food.
- h. The inhibition of the ability of aquatic plants to photosynthesize.
- i. Reduction in the feeding activity of the fish population caused by increases in turbidity.

Some mitigation measures are available to minimize the impacts of terrace extraction on terrestrial and aquatic plants and animals. These include operation standards protecting against the removal of riparian vegetation and reclamation standards for rehabilitation of riparian species in areas where they have been damaged or removed. Reclamation standards for surface pit slopes appropriate for the regrowth of native species are also proposed. Standards requiring that measures be taken to minimize stream siltation are included under previous portions of this section.

Cultural

Irreversible cultural impacts resulting from terrace extraction operations are similar to those of in-stream and hardrock operations. They include the increased use of a natural resource, the depletion of a non-renewable natural resource, and an increased demand for energy used in processing and hauling aggregate products. Monitoring of extraction and energy consumption is the only mitigation measure available and will assist in the determination of the extent of these impacts. Energy is consumed in both the processing and hauling phases of terrace operations. (See Topical Issues: Energy.)

Most of the remainder of cultural impacts are at least partially unavoidable. These include an increase in day and night noise levels, additional truck traffic and traffic hazard, an additional requirement for road maintenance, and a reduction in visual or aesthetic quality.

A daytime increase in noise levels is unavoidable. Dredging, processing, and trucking operations generate significant noise impacts, especially in areas where background noise is low. Residential areas are especially affected when they are in close proximity to mining operations. Noise levels from terrace operations are comparable to those from in-stream operations. (See Table IV-6.)

Mitigation measures available to partially reduce these impacts are standards for proper equipment maintenance, setbacks from potentially affected areas, the construction of berms or other noise barriers, or the relocation of processing operations in areas more compatible to higher noise levels. Nighttime noise impacts are more severe than daytime impacts due to lower ambient levels, but, if necessary, are additionally mitigated by standards specifying limits to the hours of operation.

Additional truck traffic and associated impacts on

traffic hazards to bicyclists, pedestrians, and other vehicles and road maintenance also result from terrace mining operations. The bulk nature of aggregates and the lack of immediate access to rail or other transportation (except in immediate Healdsburg area) means that these impacts are unavoidable. (See Topical Issues: Transportation.) Where rail transport is available, a short truck haul is still required to deliver products to the railhead. Traffic hazards to other vehicles, etc., are unavoidable in the Middle Reach. Eastside Road, Windsor River Road, and other route alternatives bring trucks into contact with other road users. Partial mitigation is available with standards for truck speed limits and warning signs, the use of alternative routes, and various traffic management facilities such as bike lanes, etc. Truck traffic on the haul roads themselves results in more rapid deterioration and the need for more frequent repair and maintenance. Eastside Road west of Windsor is a good example. A partial mitigation measure might be one which required that the mining operations which use particular haul routes contribute to their maintenance.

The final unavoidable impact resulting from terrace operations is the loss of visual and aesthetic quality. Mining operations along the valley floors interrupt the scenic quality of the stream environment and its neighboring agricultural activities, especially in areas well removed from urban or other industrial uses. Operation standards for visual screening and revegetation can reduce this impact somewhat. Reclamation standards for equipment removal and revegetation will also contribute to visual mitigation. Another measure available is the relocation of processing operations to industrial areas.

Measures are available to completely mitigate the potential impacts on police protection services, public safety, recreational opportunity, and archaeological and historic resources. The location of

large equipment and water filled excavations associated with terrace operations in a remote area can lead to an increased potential for vandalism. This may result in additional call to and responses from local law enforcement agencies. Available mitigation includes standards for fencing of the processing and excavation areas, night lighting, and private security guards.

The potential for vandalism is also increased by the construction of new access roads into farmland areas. Residents in the Middle Reach area have complained that damage to agricultural operations has resulted from vandals gaining ingress to their properties via former and present haul roads. Mitigation is available by standards requiring gates, fencing, or other means to prevent vehicle access, and/or occasional patrols of mining employees to prevent pedestrian trespass.

Potential safety hazards resulting from steep slopes, deep pits, and heavy onsite equipment are mitigable by operation standards for gates, fencing, and lighting. Worker safety can be protected by compliance with OSHA safety standards for working conditions. The potential reduction in the quality of recreational opportunity results from the close proximity of extraction, processing, and hauling operations to the river or other recreational areas. This is particularly true at Memorial Beach Park, where a haul route and processing facility occur near by. Mitigation is available in standards for setbacks from recreational areas, visual and noise buffers, and relocation of operations at a greater distance from the riparian corridor of the river. Potential losses in archaeological and historical information available at particular sites can be mitigated by site reconnaissance by qualified scientists prior to excavation and avoidance of sensitive areas.

ALL INSTREAM OPERATIONS (See Table IV-4.)

Earth

Potential impacts on the land surface resulting from the instream extraction of sand and gravel are six-fold and occur both on and off site. Bank instability can result from the excavation of steep-sided (1:1) pits or bed lowering near streambanks. This may have the secondary effect of increasing the potential for erosion of bank soils offsite. In some cases this could include prime soils in crop production. Soil erosion impacts may also result from the unavoidable removal of vegetation from the streambank. These impacts are cumulative among all operations along the river. Partial mitigation by operation and reclamation standards is available. Examples are limits on riparian removal and the placement of oversize (+3") rock in potentially unstable areas.

Unavoidable impacts include a potential reduction in beach sand replenishment, a change in topography, a possible modification of the course of the river, and the disruption and compaction of topsoil. Beach sands are ultimately replenished by stream gravels reduced in size as they are washed downstream and into the ocean. Removal of these materials from the streambed can reduce this replenishment over the long term. This potential impact is cumulative among all of the operations in each watershed. Monitoring of extraction quantities and bed and sediment load movement will be needed to determine the extent of this impact. Until such monitoring yields reliable data, the only available mitigation is a limit on the quantity of instream materials extracted.

Unavoidable changes in topography and potential impacts on the river's course are also cumulative with other operations. Little data are available to determine the exact impact of particular changes in

the streambed topography, but it is the nature of the dynamic river system to make onsite and offsite adjustments in its course to compensate for abrupt physical changes. Extensive monitoring of the regional river system will be necessary to examine these adjustments and fully mitigate these impacts basinwide.

The disruption and compaction of topsoil can result from several phases of instream operations. Soils can be compacted by heavy equipment onsite and truck traffic on and offsite. Disruption of topsoil results from the removal of riparian vegetation. Soils adjacent to the river corridor can be disrupted as a consequence of changes in the river's course which affect farmlands. Operational and reclamation standards limiting use of equipment and riparian removal will partially mitigate these impacts.

Air

The potential impacts of instream operations on air resources are unavoidable and similar to those resulting from hardrock aggregate sources. They include dust generated by processing operations and truck traffic and emissions from truck engines both on and offsite. The fact that instream materials are stream washed just prior to extraction usually means that the dust generated by processing is somewhat less than that resulting from terrace or hardrock operations. Dust and emissions from truck traffic, however, are similar to other sources. The Environmental Protection Agency (EPA) and State Air Resources Board set standards for emissions air quality. The Regional Boards require that when standards differ, the more stringent will apply. If the available mitigation measures for emissions and dust are instituted, air quality impacts can be mitigated within the study area. These mitigations include the application of water along haul roads and on drop piles for dust and vehicle compliance with emission standards for trucks. Batch plant emissions

TABLE IV-4

ALL INSTREAM OPERATIONS

	Initial Study Reference	<u>ADVERSE IMPACTS</u>	<u>MITIGATION</u>			Unavoidable	Irreversible	Long Term	Onsite	Offsite	Cumulative
			Operation Standards	Reclamation Standards	Monitor						
EARTH:	2A	UNSTABLE BANKS	X	X					X	X	X
	2B	DISRUPTION OF TOPSOIL	X	X		X			X	X	
	2C	CHANGE IN TOPOGRAPHY	X		X	X			X	X	
	2D	POTENTIAL LOSS OF PRIME SOILS FROM CROP PRODUCTION	X	X	X				X	X	X
	2E	INCREASE IN SOIL EROSION POTENTIAL	X	X	X				X	X	X
	2F	REDUCTION IN BEACH SAND DEPOSITION	X		X	X	X	X		X	X
	2G	POTENTIAL MODIFICATION OF RIVER'S COURSE	X	X	X	X			X	X	X
AIR:	3A1	EMISSIONS FROM ENGINES	X			X			X	X	X
	3A2	DUST FROM PROCESSING OPERATIONS	X			X			X	X	
	3A3	DUST FROM TRUCK TRAFFIC	X			X			X	X	
WATER:	4A	CHANGE IN COURSE OF WATER MOVEMENT	X	X	X	X			X	X	X
	4B	REDUCTION IN ABSORPTION RATE (AQUIFER)	X	X	X				X	X	X
	4C	CHANGE IN DRAINAGE PATTERN	X	X	X	X			X	X	X
	4E	FLOOD FLOW ALTERATION	X		X	X			X	X	X
	4G	SILTATION OF SURFACE WATER	X	X	X				X	X	X
	4H	INCREASED TURBIDITY	X		X				X	X	X
	4I	DECREASED GROUNDWATER SUPPLY	X		X				X	X	X
	4J	DETERIORATION OF GROUNDWATER QUALITY	X		X				X	X	X

TABLE IV-4

(Continued)

ALL INSTREAM OPERATIONS

	Initial Study Reference	ADVERSE IMPACTS	MITIGATION			Unavoidable	Irreversible	Long Term	Onsite	Offsite	Cumulative
			Operation Standards	Reclamation Standards	Monitor						
BIOLOG- ICAL:	5A	VEGETATION REMOVAL (RIPARIAN)	X	X		X			X		
	5	REDUCTION IN UNIQUE BIOTIC HABITAT	X	X	X	X			X		X
	5G	POTENTIAL LOSS OF INTENSIVE AGRICULTURAL USE	X	X	X				X	X	X
	6A	REDUCTION IN UNIQUE WILDLIFE HABITAT	X	X		X			X		X
	6D	BARRIER TO ANIMAL MOVEMENT	X	X		X			X		X
	6E	DETERIORATION EXISTING FISH OR WILDLIFE HABITAT	X	X	X	X			X	X	X
CULTURAL:	7AB	INCREASED DAY AND NIGHT NOISE LEVELS	X			X			X	X	X
	9A	INCREASED USE OF NATURAL RESOURCE			X	X	X	X	X	X	X
	9B	DEPLETION OF NON-RENEWABLE RESOURCE	X		X	X					X
	13A	ADDITIONAL TRUCK TRAFFIC			X	X			X	X	X
	13F	POTENTIAL TRAFFIC HAZARD	X			X				X	X
	13G	NEED FOR ADDITIONAL ACCESS	X	X		X			X	X	X
	13H	MAINTENANCE OF EXISTING PUBLIC ROADS	X		X	X				X	X
	15	INCREASED DEMAND FOR ENERGY			X	X	X			X	X
	18B	LOSS OF VISUAL/AESTHETIC QUALITY	X	X		X			X	X	X
	19	LOSS OF QUALITY OF RECREATIONAL OPPORTUNITY	X	X		X			X	X	X

can also be partially mitigated with the installation of scrubbers or other equipment. In addition, current monitoring programs for air quality will determine whether additional mitigation is necessary.

Water

Potential water related impacts are cumulative among all instream operations in the Russian River system and occur on and offsite. Various mitigation measures are available through either operation or reclamation standards, or both. However, the nature and extent of the impacts on river hydrology can only be determined by the institution of a comprehensive monitoring system.

Unavoidable impacts include the alteration of the course of water movement, a change in the drainage pattern, and the potential alteration of flood flows. Removal of instream gravels increases the capacity of the channel to carry stream flow, thereby reducing the amount that would flow through auxiliary channels or spread over the land surface. A possible secondary effect of the larger channel is the increased erosive potential of the flow therein. Changes in the river's course, therefore, could result from the erosion of the banks or the downgrading of the bed of the stream. Streambed lowering might result in further impacts mentioned in other parts of this section, including a potential threat to the safety of bridge structures in extraction areas. Exposure of the subsurface portion of supportive pillars can result from bed downgrading. These impacts are only partially mitigable by operation and reclamation standards. Requirements for bank protection measures, limits on the removal of riparian vegetation, and limits on the depth of extraction are available mitigation measures.

Other potential water related impacts resulting from instream extraction include a reduction in aquifer recharge rate, increased turbidity and the siltation of surface waters, and reduced groundwater supply.

When streambed excavations penetrate below water, the silt and sediments trapped among the gravels are stirred up, suspended in the flow, and later redeposited downstream. The sediments coat the coarse bed gravels and can result in a relatively impermeable layer along much of the channel. In addition, the walls and bottom of the pit itself are covered by upstream sediments. The silt layer thus becomes a barrier to aquifer recharge through the bottom of the channel. Processing operations on or adjacent to the streambed can generate similar impacts. Waste muds and wash water remaining after the washing operation could be transported downstream and deposited along the bed.

Standards prohibiting inwater extraction and processing either on the bar or adjacent to the river would be effective mitigation measures. Others available include the use of retarding basins for silt storage with disposal required before the high water period.

Groundwater supplies could be reduced by instream extraction in two ways. If aquifer recharge is slowed or the streambed is lowered over a significant portion of the river and pumpage for other valley uses continues, then the net result may be a slight lowering of the water table level in the basin. During the dry season, when natural streamflow usually feeds the aquifer, the impact would be relatively more severe. Groundwater levels may also be reduced if the mining operations also pump water for processing purposes. Pumpage varies with particular instream operations, depending on the type of product, the nature of the deposit, and the capacity of the plant.

Water supply along the river valleys is usually plentiful enough for smaller operations to occur, but the cumulative withdrawal from all operations can be determined by monitoring pumpage and water table elevations. Presently a limited groundwater monitoring program is underway cooperatively between the Sonoma County Water Agency and the State Department of Water

Resources. Additional mitigation is available through standards prohibiting processing operations along the river channel.

Biological

Potential effects on aquatic and terrestrial life resulting from instream operations include both direct and indirect impacts. Habitat destruction due to the removal of riparian vegetation and streambed siltation is similar to that resulting from terrace extraction and is discussed in that section. However, several additional impacts may occur from mining activities within the channel.

a. Aquatic plants and animals

1. Inwater extraction can result in the direct killing of fish.
2. Substrate gravel sizes necessary for fish and insect reproduction are removed.
3. Direct destruction of pool and/or riffle area by inwater extraction equipment and flattening of the streambed, particularly in the vicinity of the mouths of tributaries.
4. Stream diversions which isolate pools leave fish and other organisms to die when the pools dessicate.
5. Instream crossings can block fish migration and create large warm water ponds which favor such fish as suckers, squawfish, sunfish, and bass rather than trout and salmon.
6. Loss of riparian vegetation resulting from either streambed downgrading or lowering of the water table.

b. Terrestrial plants and animals

1. Removal of developing riparian vegetation on

the gravel bars.

2. Reduction in the diversity of plants and animals in early successional stages due to the flattening of each gravel bar.
3. Reduction in the successional development of youthful riparian growth into mature riparian forest.
4. Reduction in the available food supply for insect-eating birds resulting from streambed siltation impacts mentioned under terrace operations.

Various mitigation measures are available to reduce the potential for the above impacts of instream extraction. However, the biological impacts resulting from instream extraction are unavoidable beyond the effect of available partial mitigation measures.

Measures include operation standards for the design, location, and frequency of access roads and the control of non-mining vehicular traffic use of access routes. Additional operation standards would prohibit the use of equipment in water or mining activities near the mouths of tributary streams and specify the manner in which instream crossings would be placed and removed. Standards for limited depth of extraction, the timing of instream mining-related activities, and limited areas of extraction will further mitigate these biological impacts. Operational measures suggested in other parts of this section will mitigate impacts resulting from loss of riparian vegetation and stream siltation.

Reclamation measures include standards for grading of the gravel bar following each year's operation, for timing of operations so that fish migration and spawning activities are not threatened, for discing and revegetation of access roads, for bank armoring with oversize materials, and for replanting of denuded or ripped streambanks.

TABLE IV-5
 GENERALLY ACCEPTED CRITERIA
 FOR
 COMPOSITION OF SUBSTRATE
 MATERIALS AS RELATED TO PREFERENTIAL
 SPAWNING SITES FOR KING SALMON
 (After Van Woert, *et al.*)*

<u>Gravel Size</u>	<u>Percent of Material Present by Volume</u>
> 6-12 inches	30 or less
> 3-6 inches	10 or less
> 1-3 inches	50 or less
> 1/2-1 inch	20 or less)
> 5/32-1 inch	20 or less) 50 or less
> .015-5/32	20 or less)

*Source: Storm Engineering, 1974

Cultural

Cultural impacts resulting from instream operations are unavoidable. Increased noise levels, additional truck traffic and traffic hazards, additional road maintenance requirement for new access routes, the increased use of a natural resource, and the potential depletion of non-renewable resources are some of the impacts of instream extraction on the cultural environment.

The use of mineral resources is an irreversible impact of and is cumulative among all instream operations. Complete mitigation is not available, but monitoring of production would assist in the determination of the rate of use. Instream gravels are

a renewable resource to a degree, but their extraction can result in the depletion of non-renewable resources if the quantity removed exceeds the quantity replenished in the river system. Basinwide monitoring of both quantities is again necessary to determine the level of these cumulative impacts.

Instream extraction operations can result in increased day and night noise levels. Noise is generated by each of the extraction, processing, and transportation phases of the operations. Table IV-6 shows noise levels from a typical instream processing operation (Piombo-Geyserville, 1979).

Loader and scraper noises occur during extraction while plant noises take place during the processing phase. Daytime noise impacts are unavoidable, especially in rural areas along the Russian River and Dry Creek, where ambient noise levels are very low. The construction of noise barriers, proper equipment maintenance, setbacks from potentially affected areas, and the relocation of processing plants in other areas are available mitigation measures. Night noise can be further mitigated by limits on the hours of operation.

Additional truck traffic, traffic hazard, road maintenance, and access impacts are also unavoidable. The bulk nature of aggregate products necessitates the use of either rail or truck transportation for hauling them to markets. Extraction of river materials requires that access be obtained between major haul routes and the river through farmlands and/or the riparian corridor. Traffic hazards to bicyclists, pedestrians, and other vehicles can result when trucks use local traffic corridors. Additional road maintenance can result from heavy truck use of particular roads or bridges. The need for bridge structure maintenance might also be a secondary impact of changes in the characteristics of the stream channel resulting from instream mining. Mitigation for these impacts is discussed under the section on water-related impacts. Mitigation measures available include

TABLE IV-6
NOISE FROM INSTREAM
PROCESSING OPERATIONS

Source and Distance	Noise Level (dB(A))
<u>Stationary Plant</u>	
At Plant	100-110
At 50'	90
At 100'	78
At 200'	70
At 300'	70
<u>Loader</u>	
Idle (50')	68
Loading (50')	86
<u>Scraper</u>	
Idle (50')	70
Loading (50')	86-88
Unloading (50')	76-80
<u>Trucks</u>	
Moving (50')*	90

* Less than 2% grade

Source: Piombo, 1979

operational requirements for traffic management, road improvements, and the use of alternative routes. Mitigation in some areas, particularly the Alexander

Valley, might be achieved with the increased use of rail shipment. (See Topical Issues: Transportation.)

Other cultural impacts resulting from instream extraction are an increased demand for energy, a potential reduction in visual or aesthetic quality, and a potential loss in the quality of recreational opportunity. Energy impacts are irreversible, and available mitigation includes monitoring of County-wide aggregate industry consumption. Energy is consumed by both processing and transportation operations. The Section on Topical Issues discusses the relative energy consumption involved in mining alternative sources. In summary, though, the processing of instream gravels consumes less energy per ton produced than hardrock sources and a similar amount to terrace sources. However, the location of instream sources, especially the Alexander Valley, necessitates the use of additional fuel for transporting aggregate products to the major use areas. (See Topical Issues: Energy.)

Potential impacts on aesthetic and recreational resources can result from the use of equipment in the river channel and the removal of riparian vegetation. Much of the river valleys' aesthetic quality is derived from the interaction of agricultural activities and the stream environment. River recreationists, especially canoeists, experience this quality from the river while others view it from outside. Nevertheless, when an industrial activity is located in the stream area, this quality is unavoidably reduced. Partial mitigation is available through standards limiting the use of processing equipment within the channel and minimizing the removal of riparian vegetation.

TOPICAL ISSUES

Energy

All mining operations consume energy for the processing and transportation of aggregate products. The processing operation consumes both fuel and electricity while the hauling operation consumes only diesel fuel.

Fuel consumed to deliver aggregates to market is dependent on haul distance and per mile consumption. On the average, a truck and trailer consumes about .25 gallons of fuel per mile travelled (ACA). This figure varies with the size of the load (25-ton capacity), the speed travelled, and the number of stops and turns along the route. Assuming that these factors are relatively equal among sources, the energy consumed by the transportation of rock products is the same for all operations on a per-mile basis. Fuel efficiencies can occasionally be achieved by hauling full loads on return trips or using less energy intensive transportation alternatives.

Processing operations consume significant quantities of diesel fuel and electricity. In addition, the amount of energy used varies with the type of source and use. The production of concrete aggregates, for instance, usually requires more extensive processing than such products as road base. Also, hardrock sources generally require more extensive processing than alluvial sources for similar uses.

Diesel fuel is consumed during the processing operation by dozers, loaders, and other smaller onsite equipment. Electricity is often used by the plant itself, consisting of the crushing, screening, and washing operations. One firm which conducts both alluvial and hardrock operations has estimated its fuel and electricity consumption in both dollars and energy units. Fuel consumed averages nine cents

TABLE IV-7

ENERGY COST PER TON* AT VARYING DISTANCE FROM MARKET¹

<u>Haul Distance</u>	<u>Hardrock Cost</u>	<u>Alluvial Cost</u>
1. At plant	\$.27	\$.20
2. 5 miles	.32	.25
3. 10 miles	.37	.30
4. 20 miles	.47	.40
5. 40 miles	.67	.60

* Fuel cost is 1¢ per ton/mile
(.25 gallon/mile; 25 ton load; \$1.00/gal.)

¹One-way hauls

per ton for alluvial sources and 13 cents per ton for hardrock aggregates. Energy consumed is 19,600 btu/ton and 28,000 btu/ton, respectively. Electricity costs for processing are estimated at 11 cents per ton for alluvial and 14 cents per ton for hardrock sources. Energy consumption is 1.5 kilowatt hours/ton and 2.0 kilowatt hours/ton, respectively. (Quarry Products, Inc., 1979).

Clearly, from the figures above, hardrock aggregates consume more energy on a per-ton basis for processing operations than do producers of alluvial aggregates. A hardrock plant, for example, which produces 250,000 tons per year will consume 7 billion btu in fuel and 500,000 kilowatt hours of electricity annually. An alluvial operation with the same capacity will consume about 70% of the fuel (4.9 billion btu) and 75% of the electricity (375,000 kwh).

The total energy consumption of an operation must

include, however, both processing and delivery factors. If hardrock plants spend more energy for processing operations, but can be located nearer to the point of use than alluvial sources, then total energy consumed per ton may actually be less. The numbers on Table IV-8 illustrate the effect of the delivery factor on energy costs.

In every case, hardrock operations at the same distance from market as alluvial operations spend an additional 7¢/ton for energy use. However, where hardrock operations are exactly seven miles closer to market, energy usage is approximately the same. For example, an alluvial operation at a 20-mile distance will spend 40¢ per ton, while a hardrock operation at 10 miles will spend only 37¢ per ton. In face, alluvial sources are much further removed from the principal market areas of the region than hardrock sources. The following table compares energy costs per ton from sources in different locations within Sonoma County to Rohnert Park, a centrally located market.

TABLE IV-8
ENERGY COST PER TON
TO ROHNERT PARK

	Alluvial		Hardrock	
	From Geyser- ville	From Healds- burg	From Roblar Road	From Hardin Lane
	36 mi.	28 mi.	10 mi.	12 mi.
At plant	\$.20	\$.20	\$.27	\$.27
At desti- nation	\$.56	\$.48	\$.37	\$.39

TOPICAL ISSUES

Transportation

In order to place in the proper perspective the amount of truck traffic generated by aggregate operations in particular locations, an examination of the Countywide transportation of these materials is necessary. As mentioned in previous sections, aggregates are a high bulk, low cost commodity. Transportation costs, therefore, are a significant portion of the delivered price. At the same time, extraction operations must, of necessity, locate where the resource deposit is found. Since deposits are not often found where alternative means of transportation (rail, barge) are available, truck hauls are frequently the only available method of delivery.

The costs of truck transportation include fuel, insurance, driver labor, maintenance, the truck, and taxes. In 1978, truck haul costs were estimated at slightly over \$30 per hour, or 9-10 cents per ton per mile. Present costs are estimated at about \$40 per hour, or 12-13 cents per ton per mile. Truck and transfer trailer capacity is about 25 tons with a diesel fuel requirement of about .25 gallons per mile. Firms in Sonoma County either own and operate their own trucks, contract with independent trucking firms, or depend on consumers to haul their own purchases from the extraction or processing site.

Presently, aggregate operations in Alexander Valley, Dry Creek Valley, and the Middle Reach must haul their products from 15 to 30 miles one way to the Santa Rosa area. That distance can add at least \$1.50 to \$3.00 per ton, or \$37.50 to \$75.00 per load, to the materials delivered price (at 10 cents per ton per mile). The increased cost is even more significant for longer deliveries (time and distance) to South County markets. For example, deliveries to Sonoma, a distance of 45-60 miles, the cost is over \$4.50 to \$6.00 per ton, or \$112.50 to \$150.00 per

load, to haul. As long as the source of aggregate materials is at a distance from market areas, haul costs will continue to be the largest portion of the delivered product's cost. As a result, the additional truck traffic generated by distant sources is more significant than that from local sources.

The accompanying map indicates the routes presently used to haul aggregates mined in Sonoma County. U. S. 101 is the major route, due to its north-south alignment and the proximity of urban centers along its axis. The routes also reflect the present pattern of production and consumption of river materials described in Section III on aggregate demand.

Many existing and potential hardrock sources are found in closer proximity to markets than present river sources. Although many existing quarries are located in remote areas where both haul distances and driving time are high, some existing and many potential sites are close enough to central and southern County urban areas to significantly reduce haul time and distance.

In some instances, rail or barge shipment is an alternative method of delivery. Rail shipment is currently used by sand and gravel producers near Healdsburg to haul products to southern Sonoma and Marin County markets. Essential to the use of rail transport is the proximity of lines to either extraction processing or delivery points. Rail rates are approximately 6.5-7.0 cents per ton/mile, or slightly more than 50% of truck costs. These costs are increased, though, if the product must first be hauled by truck to the rail line, unloaded, and reloaded onto the train before shipment.

The Northwestern Pacific Railroad line runs north and south through Sonoma County, connecting Alexander Valley, Healdsburg, Windsor and Santa Rosa with Petaluma and Marin County. It may be a viable alternative for delivery of either raw or processed materials to and from those locations. Instream

sources in the Alexander Valley, processing operations near Windsor, and batching operations around Santa Rosa are close to rail transport lines.

Shipment of products by barge is less frequently used by Sonoma County producers. However, several Bay Area companies which mine Bay and Delta sands ship them to various shoreline markets by barge. The estimated one cent per ton/mile transportation costs are extremely low compared to those for truck or rail. As in rail shipment, the use of barges for hauling aggregates is limited by the proximity of navigable waterways and docks to rock sources or markets. South County markets, though, could be served by deliveries made along the Bay, the Petaluma River, or Sonoma Creek.

TOPICAL ISSUES

Agriculture

The impacts of mining operations on agriculture in Sonoma County are such that a comprehensive view of the relationship between agriculture and mining uses is necessary. The mining of each source of aggregate materials results in the loss of agricultural land, but the nature of the conflict is different in each case. The importance of the agricultural resource to the County's economy warrants its consideration whenever it is threatened by competing uses. To completely avoid all potential land use conflicts is certainly impossible. However, in Sonoma County, it is possible to obtain sufficient aggregate materials in the future in a manner that minimizes the potential loss of agricultural land. The following discussion provides a brief description of the viability of agriculture in the valleys and its relationship to agricultural potential Countywide.

Approximately 525,000 acres of land in Sonoma County are in some form of agricultural production. Included are both extensive (grazing, forage crops) and intensive (vineyard, orchard, row crops) uses. Of the more than 43,000 acres of intensive crop production in the County, over 13,400 (31.1%) acres are in the major production areas of Alexander, Dry Creek, and Middle Reach Valleys. Over 10,000 of the 26,000 acres in grape production take place in the valleys as well. Another 2,200 acres of range and pasture also occur within the study boundaries.

Approximately 80,000 acres of prime soils (Class I and II capability unit by S.C.S.) exist in Sonoma County. Of this total, over 12,000 (15%) are in the study area. Of the 20,796 acres of Class I soils, over 5,000 (25%) occur in these valleys. Finally, an estimated one-third of the unique Yolo-Cortina-Pleasanton Soil Association is found in the flood plains of the study area.

Of the 80,000 acres of Class I and II soils in Sonoma County, 33% (ACA 1978), or approximately 26,667 acres, are indicated as non-agricultural uses in the General Plan. Much of this area, however, was developed prior to formulation of the Plan, which recommends that urbanization occur primarily around presently developed areas.

Agricultural viability in the valleys is determined by several factors; soil productivity, climatic conditions, water availability, and the rooting habits of selected crops. The Yolo-Cortina-Pleasanton Association soils described in Section II have few limitations on their potential for crop production. These flood plain soils average about 10-12 feet thick with the Yolo series often exceeding 12 feet in depth. The large available root zone increases the potential for deep rooting crops. The boundaries of the soil types in the Association are not well defined. Often, extremely permeable areas of the Cortina series are interspersed among the other types. All of the soils in the association

are fairly easily managed for crop production and most rank highly according to present soil rating systems.

Two methods are used by most agencies to rate soil productivity and compare the agricultural viability of soil types. The U. S. Department of Agriculture's Soil Conservation Service (SCS) system places soil types in "capability units", or classifications of soils by their suitability for similar crops, their similarity in management requirements, and their productivity. Capability units and sub-classes are grouped into eight broad soil classes, from Class I soils which have few limitations, to Class VIII soils, which have limitations which totally preclude their use for crop production. (See Appendix B.)

The second method of ranking soil productivity is the Storie Index rating system. This system numerically expresses a soils suitability for farming based on its soil characteristics only. (See Appendix C.) Soils are rated from 1-100 for each of four categories, then an overall rating (1-100) is computed. The rating places the soil type in one of six "grades". The highest, Grade I, includes soils rated from 80-100. The lowest is Grade VI (0-10). In general, the agricultural use of the soil type is the major consideration in this ranking system. Because each of the two systems is useful in its own way, many agencies consider both.

Soils of the Yolo-Cortina-Pleasanton Association rank fairly high in either system of classification. Under the SCS system, the Yolo, Pleasanton, Pajaro, Manzanita, Arbuckle, and Zamora series, among others, are either Class I or II and considered to be "prime" soils for agricultural production. That is, the fewest limitations prohibit and the least management is required for crops in these soils. They also have high Storie index ratings. Many of the Yolo loams have perfect 100 ratings, while all of the Yolos and some of the Pleasantons exceed 80 (Grade I). The soils which are classified by SCS as Class II generally have Storie index ratings between 60 and 80

(Grade II), although several rate below 60 (Manzanita, Arbuckle).

The Cortina soil series has the lowest rating of soils which comprise the Association, Class IV (SCS) and Grades III and IV (Storie Index). The chief limitation to the use of these soils is their high permeability. Water retention can be a problem late in the dry season due to the lack of moisture in the soil. More frequent irrigation is required for crops grown in Cortina soils, placing an additional demand on water resources. Approximately 18,000 acres of land in Sonoma County is covered by Yolo soils (SCS) with over one-half of this total occurring within the study area. Over 5,000 acres in the area are Class I soils (SCS) with Storie Index ratings between 80 and 100. Pleasanton, Yolo, and Zamora soils are the only Class I soils in Sonoma County.

Climatic conditions and water availability in the valleys are ideally suited for the production of a wide variety of crops. The long growing season, ample heat and solar support, and the proximity of groundwater for irrigation in addition to the depth of the flood deposited soils combine to make the valleys an ideal agricultural production area. Past crops have included hops, prunes, apples, pears, cherries, and grapes. Present orchard and vineyard crops continue to be well-suited to the warm climate and deep flood plain soils of the Yolo-Cortina-Pleasanton Association. Their deep root systems occupy much of the available soil profile and are able to make use of soil-stored water. In normal years, adequate quantities are available to maintain plant vigor into the late summer in many of the prime soils. Cortina and some other soils require earlier and more frequent irrigation, again depending on climate demand.

The climate of the study area is especially suited for wine grape production. Only particular parts of Western Europe, Chile, the New Zealand coast,

TABLE IV-9

SOIL CLASS ACREAGE

<u>Class</u>	<u>Alexander Valley</u>	<u>Dry Creek Valley</u>	<u>Middle Reach</u>	<u>Total Study Area</u>
I	1,480	1,848	1,810	5,138
II	3,365	1,964	2,042	7,371
III	950	150	360	1,460
IV	2,330	100	529	2,959
VI	900	107	496	1,503
VII	1,345	44	409	1,798
VIII	1,390	698	548	2,636

and South Africa have the same unique combination of climatic and soil factors which can support the production of a wide variety of grapes. The portion of the Middle Reach below Windsor River Road is the only area which differs slightly from the above climate. The intrusion of marine fogs tends to cool the area and reduce solar support and climate demand. The different conditions limit somewhat the number of varieties that can be grown. Grape yields for the various soil types in the valleys are very high. According to the SCS, the average yield is 15 tons per acre in Yolo, Pleasanton, and Manzanita soils and 8 tons per acre in Zamora, Pajaro, Cortina, and Arbuckle soils.

The alluvial soils which are valuable for their agricultural products are also valuable for the aggregate resources that underlie them. One of the important features of the Yolo-Cortina-Pleasanton Association is its good drainage. This well-drained quality is related to the sandy, gravelly strata below the soil profile. The possible use of the sands and gravels for aggregate results in a direct con-

flict between the use of the land for its agricultural and mineral resources. The nature of this conflict is such that, once the mineral resource is extracted, the agricultural use is permanently precluded. (See Section VII.)

However, as long as the land is used for crop production, the mineral resource is not lost, but instead remains as a potential reserve.

Instream sources of mineral aggregate have a potential conflict with agricultural uses in a different way. Hydrologic impacts resulting from instream extraction could lead to the loss of croplands through erosion caused by downgrading of the bed and bank undercutting. Although subsequent floods and the downstream migration of gravels can rebuild soils over time, the eroded soils are essentially irreplaceable. It appears that some extraction may be possible without the loss of valuable soils, but the exact limits need to be determined.

Hardrock aggregate sources potentially conflict with the use of land for grazing or other extensive agricultural uses. Many hillside quarries are presently located in rock formations which underlie good range and pasture land. As long as the quarry is in operation, grazing is precluded within the quarried area. However, with proper reclamation, the entire quarry site could be returned to range land upon completion of the operation. Furthermore, hardrock operations produce a greater tonnage of material per extracted area than do either terrace or instream operations. (See Table IV-10.) In areas where large acreages are available for grazing, a relatively small quarry site does not significantly affect the agricultural use.

TABLE IV-10

Source	Tons Per Acre ¹
Terrace	130,000
Instream	90,000
Hardrock (existing sites)	235,000
¹ Tonnage figures include adjustments for pit slopes and setbacks. Source: Sonoma County Planning Division	

In summary, a conflict over land use exists between mining and farming uses. The conflict is clearly more direct and severe with the mining of alluvial soils. It is potentially severe with instream operations, while the mining of hardrock sources results in the least severe impact on agriculture. As a result, limited inchannel extraction and hardrock mining can occur with a minimal effect on the County's available farmland.

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V. ALTERNATIVE MANAGEMENT PLANS

This Section describes five alternative management strategies, or plans, which have been developed not only as a means of providing a series of management options, but also as a means of clearly illustrating the economic and environmental consequences of mining each of the alternative sources.

The five alternative management plans described herein are:

- Option 1. A continuation of the present reliance upon alluvial terrace and instream sources for most of the concrete, asphalt concrete, pipe bedding and trench backfill, and road base uses; or approximately 70% of future aggregate supplies. Reliance upon existing hardrock quarries for future subbase and fill aggregate.
- Option 2. Reliance upon instream sources for future supplies of concrete, asphalt concrete, bedding and trench backfill, and road base; or about 75% of future aggregate supplies. The remainder of uses would be supplied by hardrock sources. This option would include a three-year transition period for present alluvial terrace operations.
- Option 3. Reliance upon alluvial terrace sources for future supplies of concrete, asphalt concrete, bedding and trench backfill, and road base (75% of future supplies). Reliance upon hardrock sources for the remainder of fill and subbase materials. This option would include a three-year transition period for instream operations.
- Option 4. Reliance upon hardrock sources for future

supplies of all uses. Instream sources would be available for stream management purposes only. This option would include a three-year transition period for alluvial terrace operations.

- Option 5. Reliance upon hardrock sources for future supplies of all uses but concrete. Concrete aggregates would be mined from alluvial terrace sources supplemented by a limited supply of instream gravels for stream management purposes.

The following Section discusses each of the above options in more detail and includes an assessment of (1) supply and demand considerations, (2) the suitability of materials made available, (3) the potential environmental impacts, and (4) the potential economic impacts.

OPTION 1: Supply and Demand

Under the present pattern of supply, alluvial terrace and instream sources produce aggregate materials for virtually all Portland Cement Concrete. In addition, stream worked gravels supply most of asphalt concrete, pipeline bedding and trench backfill and road base uses. Hardrock quarries supply most subbase, drain rock and fill materials, and some asphalt concrete and road base. Under Option 1, this pattern would continue. Sufficient reserves would be made available so that each source could continue to supply its present percentage of the demand for each use according to estimates based on the 1978 survey of aggregate producers (Sonoma County Planning Division) as shown on Table III-3.

Tables V-1 and V-2 show the relative portions and tonnages which would be supplied by each source for each use category.

TABLE V-1

Use	Terrace	Instream	Hardrock
1. Concrete	95% ¹	5%	--
2. Asphalt Concrete	60%	5%	35%
3. Base	50%	23%	27%
4. Subbase	--	--	100%
5. Bedding/Trench Backfill	5%	95%	--
6. Other Fill	--	3%	97%
7. Drain Rock	--	15%	85%
8. Other Uses ²	40%	25%	35%

¹ Percentages are used to protect proprietary nature of supply information.

² Other uses may include some of the first 7 categories, if those products were only a small portion of a particular firm's business.

A 50-year demand of almost 80 million tons of aggregate from alluvial terrace sources would require approximately 230 acres by the year 2000 and about 600 acres over a 50-year period. These acreage figures could be much greater, however. Presently, the construction markets require a slightly higher percentage of sand to gravel than is available in the terraces south of Healdsburg. If this characteristic holds true for future reserves, about 120 acres of additional terrace lands would be required, bringing the 20-year total to 275 and the 50-year total to 720 acres.

TABLE V-2 : TONNAGES (IN MILLION TONS)

Use	Demand*		Terrace		Instream		Hardrock	
	20 yr.	50 yr.	20 yr.	50 yr.	20 yr.	50 yr.	20 yr.	50 yr.
Concrete	16.5	43.7	15.7	41.5	0.8	2.2	--	--
Asphalt Concrete	7.8	20.6	4.7	12.4	0.4	1.0	2.7	7.2
Base	14.0	37.1	7.0	18.6	3.2	8.5	3.8	10.0
Subbase	7.8	20.5	--	--	--	--	7.8	20.5
Bedding/Trench Backfill	6.9	18.3	0.3	0.9	6.6	17.4	--	--
Other Fill	1.5	4.1	--	--	-0-	0.1	1.5	4.0
Other Uses	6.1	16.2	2.5	6.5	1.5	4.0	2.1	5.7
TOTAL	62.3	165.0	30.2	79.9	12.8	33.9	19.3	51.2

* Survey of aggregate producers 1978/79

A 50-year demand of almost 40 million tons derived from instream sources would require an annual extraction level of 660,000 tons by skimming or 440 acres by pit extraction (90,000 tons per acre). The Russian River in Alexander Valley would be the primary source of these supplies, since replenishment in Dry Creek and the Middle Reach will most likely be reduced by Warm Springs Dam. Since the estimated replenishment rate in Alexander Valley is about 60,000 tons per year (Sonoma County Water Agency), the result would be an overdraft of about 600,000 tons per year.

A 50-year demand in excess of 51 million tons from hard-rock aggregate sources can be met from the reserves of existing quarries within the limits set by present property lines, setbacks, and final slopes. One exception does exist, however. A shortfall in supplies of asphalt concrete might occur between the 20-year and 50-year horizons. The remainder of the 7.2 million ton demand for asphalt concrete (approximately 1.5 million tons) would require either a new quarry site or the addition of new processing equipment at an existing site. In any case, the acreage requirement for supplying 51.2 million tons of aggregate from quarries would be about 220 acres (235,000 tons per acre).

Material Suitability: (See Section III for review of suitability of each source for particular uses.)

For concrete uses, naturally rounded aggregate would be available from alluvial sources with processing limited to screening, washing, and classifying. If supplemental sand sources are not exploited and additional terrace lands are not made available, then some crushing for finer sized particles would be necessary. Some additional processing of instream materials will be necessary whenever the bars are re-mined.

For asphalt concrete and road base uses, alluvial materials would have to be crushed to the extent that fractured particles are specified by consumers. However, crushed sands and gravels produce neither as stable a road base, nor as skid resistant a road surface, as crushed hardrock. Hardrock sources that supply asphalt concrete will have to either crush extensively or supplement their product with sands from other sources.

Subbase, drain, and fill material will be adequately supplied by existing hardrock sources. Pipeline bedding materials will be available from terrace and instream sources, but the sand content requirement may mean that these materials will be in short supply over the long term unless either additional terrace lands, instream sources downstream of Wohler Bridge, or other supple-

mental sand sources are mined. Trench backfill material will be available from alluvial sources if native subsoils are not available. Hardrock aggregates can be used for trench backfill (sometimes specified as Class II aggregate base) with some additional compaction when placed.

Environmental Impacts: (Review Section IV for review of potential impacts resulting from mining operations.)

Another 220 acres of mined lands will be added to the 280 acres mined at existing quarry sites. However, very little additional increment of impact will occur from any of the existing hardrock operations, since the present rate of extraction will continue. The development of a new quarry site or the expansion of an existing site for asphalt concrete may result in impacts occurring in a new area, but the potential impacts of the operations will be mitigated by reclamation requirements, with the exception of those which are unavoidable or irreversible.

Additional impacts will result from mining as many as 720 more acres of alluvial terrace lands. Agricultural lands will be reduced by the same figure. Groundwater loss to evaporation will approach 2,900 acre feet annually, accompanied by an increased potential for lowering of the water table. Truck traffic through Windsor will continue unless an alternate route is developed. (See Section VI-B "Aggregate Use Plan.") Energy consumption will be 3.67 trillion Btu for processing fuel and 273.1 million kwh of electricity over 50 years. Fuel consumption for transportation will continue at present levels and total approximately 108,750,000 gallons.

Since instream sources will be expected to supply about 660,000 tons per year on a sustained basis, the potential environmental impacts will increase substantially. Mining in excess of the replenishment rate will downgrade the streambed over time. If replenishment is approximately 60,000 tons per

year (Sonoma County Water Agency, 1971), then the safe yield for 50 years would be approximately 3 million tons. Therefore, a total extraction of 33.9 million tons would exceed the safe yield by 30.9 million tons and result in a net lowering of the Russian River channel in Alexander Valley by an average of over seven feet (33.9 million tons, 1,685 acres, 90,000 tons/acre at 40' depth).

Potential secondary impacts resulting from channel downgrading would include the loss of riparian vegetation and farmland through erosion; loss of fishery habitat; turbid waters and subsequent siltation of the streambed; threatened failure of Jintown, Geyserville, Crocker Road, and Preston Bridges; downgrading of the stream channel in Mendocino County; loss of soil replenishment in the flood plain; and a reduction in beach sand replenishment. Flood control benefits would be increased by the added channel capacity, if extensive bank armoring were undertaken to minimize loss of streambank lands through erosion.

Other potential impacts resulting from instream extraction would also continue, although the proposed extraction level of 660,000 tons per year would be somewhat lower than the present 800,000 tons per year. The location of each year's mining activities might vary, however, depending on the availability of gravels on particular bars.

Economic Impacts:

Employment:

The number of people employed in the aggregate industry will likely remain constant in relation to the demand for construction materials.

Tax Revenues:

Assuming that property tax assessment practices do not change with respect to mined and potentially minable lands, net tax revenues over a 50-year period

to the County of Sonoma would be \$1,176,000 less than revenues from those same lands unmined. Table V-3 shows a breakdown of property tax revenues by source, using current dollars (1979). Total revenues from sales, equipment, and road taxes are expected to remain constant, regardless of the source of material.

Aggregate Prices:

On the whole, per ton prices of aggregate materials will likely change only in relation to demand factors. Hardrock operations will continue to have difficulty competing in markets for some products due to not only the higher extraction and processing costs involved, but also to the fact that most of the existing quarries with suitable raw materials have no particular advantage in proximity to markets and new sites would not be permitted. Terrace operations will continue to compete favorably with instream operations due to their relative proximity to urban centers. In fact, the permitted terrace reserves would probably be exhausted relatively quickly when available, with much of the distant instream supply held in reserve.

Option 2: Supply and Demand

Under Option 2, most future supplies of aggregate would be mined from the Russian River channel in Alexander Valley. Only subbase, drain rock, and fill materials would be mined from hardrock operations. No aggregates would be mined from alluvial terraces after a three-year transition period. In-channel gravels in Alexander Valley would be mined by the pit method, similar to mining operations in the Middle Reach during the 1950's and 1960's.

Tables V-4 and V-5 show the relative percentages and tonnages supplied by each source for each use category under Option 2.

TABLE V-3: OPTION 1

PROPERTY TAX REVENUES

	ASSESSED VALUE PRIOR TO MINING	ASSESSED VALUE DURING MINING	ASSESSED VALUE AFTER MINING	CHANGE IN ASSESSED VALUE (Col. 1&3)	ACRES MINED	REVENUES
Terrace	\$6,000 ⁽²⁾	\$6,000	\$200	\$5,800	720	-\$3,132,000 ⁽⁴⁾
Instream ⁽¹⁾	200	1,000	200	-0-	1,685	+ 2,022,000 ⁽⁵⁾
Hardrock	500 ⁽³⁾	500	200	300	220	- 66,000
TOTAL CHANGE						<u><u>-\$1,176,000</u></u>

(1) Skimming method

(2) Vineyard or orchard

(3) Grazing Land

(4) 3% tax rate and change in assessment in effect for an average of 25 years

(5) Instream skimming is assumed to be continual for 50 years on all acres and 3% tax rate

1979 dollars and assessments

TABLE V-4

Use	Terrace	Instream	Hardrock
1. Concrete	14% ^{1,2}	86%	--
2. Asphalt Concrete	--	100%	--
3. Base	--	100%	--
4. Subbase	--	--	100%
5. Bedding/Trench Backfill	--	100%	--
6. Other Fill	--	--	100%
7. Drain Rock	--	50%	50%
8. Other Uses ³	--	45%	55%

¹ Transition period.

² Percentages are used to protect proprietary nature of supply information.

³ Other uses may include some of the first 7 categories, if those products were only a small portion of a particular firm's business.

A fifty-year demand of over 123 million tons of aggregate from inchannel sources in the Alexander Valley would require that all of the 1,211 acres of primary reserves be mined to the maximum depth of 40 feet below water level

TABLE V-5 : TONNAGES (IN MILLION TONS)

Use	Demand		Terrace		Instream		Hardrock	
	20 yr.	50 yr.	20 yr.	50 yr.	20 yr.	50 yr.	20 yr.	50 yr.
Concrete	16.5	43.7	6.0	6.0	10.5	37.7	--	--
Asphalt Concrete	7.8	20.6	--	--	7.8	20.6	--	--
Base	14.0	37.1	--	--	14.0	37.1	--	--
Subbase	7.8	20.5	--	--	--	--	7.8	20.5
Bedding/ Trench Backfill	6.9	18.3	--	--	6.9	18.3	--	--
Other Fill	1.5	4.1	--	--	--	--	1.5	4.1
Drain	1.7	4.5	--	--	.85	2.25	.85	2.25
TOTAL	62.3	165.0	6.0	6.0	42.75	123.25	13.55	35.75

and another 38 acres of secondary reserves to the maximum depth of 20 feet. A total of 473 acres over 20 years, 1,249 acres over 50 years, would be mined. About 5% more (62 acres) would be required if setbacks from the riparian corridor were a condition of permits. If supplemental sources of fine sands are mined and used, then the acreage requirement might be reduced by a small amount.

A fifty-year demand of almost 36 million tons from hard-rock sources could be met from existing quarry sites with no need for expansion of any operation. The number of acres which would be mined by the year 2000 would be 58 and, over 50 years, 153.

Alluvial terrace sources would be phased out under Option 2 over a three-year period. Six million tons would be produced during that period from approximately 55 acres.

Material Suitability: (See Section III for review of suitability of each source for particular uses.)

Subbase, drain rock, and fill materials would be available in adequate quantity and quality from hardrock sources. Neither supplemental sands nor extensive crushing for fines would be required since most products requiring large portions of fine particles would be available from instream deposits.

The extensive use of instream materials would provide rounded particles for concrete, bedding and backfill uses. However, crushed round rock instead of crushed hardrock could be used for asphalt concrete and road base with an attendant loss in road quality. Raw aggregate mined in the Alexander Valley is generally larger in size than that from lower river and terrace deposits.

As a result, unless supplemental sands are imported from other sources, more extensive crushing would be necessary per ton than present operations require in the Middle Reach.

Environmental Impacts: (See charts in Section IV for review of potential impacts resulting from mining operations.)

Most of the potential impacts resulting from alluvial terrace extraction operations would no longer occur after the three-year transition period. The irre-

versible impacts, change in topography, groundwater levels and evaporation, loss of agricultural lands, the use of a non-renewable natural resource and the consumption of energy would not be totally mitigated, however. An additional 55 acres of farmland would be lost. Increased groundwater evaporation would exceed 220 acre feet annually.

Other potential impacts would either be discontinued by the conclusion of operations (noise, truck traffic, etc.) or would be mitigated by reclamation standards (vegetation removal, slopes, etc.).

Potential impacts related to hardrock aggregate mining would be reduced in proportion to the reduction in supplies from quarry sites. The acreage requirement is significantly less relative to Option 1 (153 and 220 acres, respectively).

Potential impacts resulting from the Option 2 instream extraction activities would greatly increase. Extraction would exceed the annual rate of replenishment by 2.4 million tons each year and exceed the total safe yield by 120.25 million tons over 50 years. The resultant drop in streambed elevation from the mining activity is estimated at slightly less than 30 feet (123.25 million tons, 1,685 acres, 100,000 tons/acre at 40' depth). The potential secondary impacts resulting from the channel deepening would include the loss of riparian vegetation and farmland through undercutting of the existing banks, loss of fishery habitat, turbid water and subsequent siltation of the streambed, lowered groundwater table, threatened failure of bridge structures, an increase in stream channel degradation in Mendocino County, loss of soil replenishment in the Alexander Valley flood plain, and a reduction in beach sand replenishment. Flood control benefits could be significantly increased by the increased channel capacity, but at the cost of the extensive armoring that would be required for the stability of the streambanks.

Other impacts associated with instream extraction would also increase. The generation of dust and noise would increase in the Alexander Valley, and County-wide truck

traffic would be significantly increased by the added haul distance to urban markets. In addition, truck access routes to the river would have to be found, either along the riparian corridor or through agricultural lands. The extensive extraction activities instream would also potentially decrease the quality of visual and recreational opportunities in Alexander Valley. Finally, energy consumption for mining activities would approximate 3.6 trillion Btu's for processing fuel and 265.5 million kwh of electricity. Trips to Santa Rosa from Alexander Valley would use about 50% more fuel than would trips from Healdsburg under Option 1.

Economic Impacts:

Employment in the sand and gravel industry would likely remain fairly constant, depending on technological change and market demand for construction materials. Employment in the trucking industry, though, could double for sand and gravel operations due to the increased haul time from Alexander Valley to urban centers of Santa Rosa and Petaluma. Hardrock employment would decrease due to the reduction in supplies from quarry operations. Furthermore, each cutback in quarry tonnage decreases employment at a more rapid rate than similar cutbacks in sand and gravel operations, due to the larger required work force per ton production.

Revenues from aggregate operations would remain constant from sales and equipment taxes. Road taxes would increase due to the greater number of trucks involved in hauling operations.

Property tax revenues realized over the 50-year period would be considerably different under Option 2 than under Option 1. Option 2 net revenues from mined lands would probably be more than 139,000 dollars greater than they would be if the lands were not mined.

Sand and gravel prices would undoubtedly increase on a per-ton basis due mostly to the increased haul distance required to deliver aggregate to urban areas. The haul cost (price of fuel, labor, insurance, taxes) from

Geyserville to Santa Rosa is about 1.5 times the cost from Healdsburg to Santa Rosa. An increase in sand and gravel price would mean that hardrock sources closer to delivery points would enjoy a competitive advantage if they were to enter the markets for concrete, asphalt concrete, etc. Therefore, Option 2 would likely result in strong economic pressure to open up hardrock or terrace sources.

Option 3: Supply and Demand

Option 3 relies heavily upon alluvial terrace sources for future supplies of aggregate materials. The flood plain of the Middle Reach of the Russian River south of Healdsburg would be the site of terrace operations. Supplies of subbase, drain rock, and fill materials would be mined from hardrock sources as in Option 2. A three-year transition period for instream operations would supply some 2.5 million tons of aggregate at present levels.

Tables V-7 and V-8 show the relative percentages and tonnages supplied by each source for each use category under Option 3.

A fifty-year demand of over 138 million tons (47 million tons over 20 years) of aggregate from terrace sources in the Middle Reach would require about 408 acres over 20 years and 1,073 acres during the 50-year period, assuming setbacks, pit slopes and additional acreage for sand supply. Of the acreage available in the Middle Reach, this level of demand would require almost all of the lands containing "measured" and "indicated" reserves (1,424 acres) from the primary area.

A fifty-year demand of 34 million tons from quarry reserves could be met by existing quarry sites as in Option 2. 145 acres would be mined in 50 years, 55 in 20 years. Approximately 2.5 million tons would be supplied by instream sources during a three-year transition period. Instream operations would be limited to skimming over a few bars (estimated 400 acres).

TABLE V-6: OPTION 2

PROPERTY TAX REVENUES

	ASSESSED VALUE PRIOR TO MINING	ASSESSED VALUE DURING MINING	ASSESSED VALUE AFTER MINING	CHANGE IN ASSESSED VALUE (Col. 1&3)	ACRES MINED	REVENUES
Terrace	\$6,000 ⁽²⁾	\$6,000	\$200	\$5,800	55	-\$ 9,570 ⁽⁴⁾
Instream ⁽¹⁾	200	4,000	200	-0-	1,249	+ 150,000 ⁽⁵⁾
Hardrock	500 ⁽³⁾	500	200	300	153	- 1,377
				TOTAL CHANGE		<u><u>+\$139,053</u></u>

(1) Deep pit extraction method

(2) Vineyard or orchard

(3) Grazing land

(4) 3% tax rate and assume change in assessment occurs in 25 years

(5) \$4,000 per acre for 1 year is added to revenues

1979 dollars and assessments

TABLE V-7

Use	Terrace	Instream	Hardrock
1. Concrete	94% ¹	6%	--
2. Asphalt Concrete	100%	--	--
3. Base	100%	--	--
4. Subbase	--	--	100%
5. Bedding/Trench Backfill	100%	--	--
6. Other Fill	--	--	100%
7. Drain	50%	--	50%
8. Other Uses ²	55%	--	45%

¹Percentages are used to protect proprietary nature of supply information.

²Other uses may include some of the first 7 categories, if those products were only a small portion of a particular firm's business.

Material Suitability: (See Section III for review of suitability of each source for particular uses.)

Subbase, drain rock, and fill materials would be available from hardrock sources as in Option 2. Alluvial

TABLE V-8 : TONNAGES (IN MILLION TONS)

Use	Demand		Terrace		Instream		Hardrock	
	20 yr.	50 yr.	20 yr.	50 yr.	20 yr.	50 yr.	20 yr.	50 yr.
Concrete	16.5	43.7	14.0	41.2	2.5	2.5	--	--
Asphalt Concrete	7.8	20.6	7.8	20.6	--	--	--	--
Base	14.0	37.1	14.0	37.1	--	--	--	--
Subbase	7.8	20.5	--	--	--	--	7.8	20.5
Bedding/Trench Backfill	6.9	18.3	6.9	18.3	--	--	--	--
Other Fill	1.5	4.1	--	--	--	--	1.5	4.1
Drain	1.7	4.5	.85	2.25	--	--	.85	2.25
Other Uses	6.1	16.1	3.4	8.9	--	--	2.7	7.2
TOTAL	62.3	165.0	47.01	128.4	2.5	2.5	12.8	34.1

terrace sources would supply rounded materials as would instream sources under Option 2. The generally finer particle size in the Middle Reach compared to the Alexander Valley would reduce the extent of crushing necessary for most uses. A reduction in road quality would occur with this option as a result of the use of crushed round rock as opposed to crushed hardrock (see Option 2).

Environmental Impacts: (See charts in Section IV for review of potential impacts resulting from mining operations.)

The potential impacts resulting from instream extraction would gradually decline following the three-year transition period. Downgrading of the streambed resulting from overdrafting the supply in Alexander Valley by 2.32 million tons would likely continue to generate hydrologic impacts within the channel and along its banks. Assuming that replenishment continues at 60,000 tons per year, another 40 years might pass before bed elevations approached present levels. In the meantime, potential loss of fishery habitat, loss of soil replenishment on the flood plain, and a reduction in beach sand replenishment could occur along with the possible benefit of some localized drop in flood elevation due to increased channel capacity. However, other potential impacts such as noise, dust, traffic, etc., will be discontinued after three years by the cessation of operations in Alexander Valley.

Potential impacts associated with the extraction of hardrock aggregates would be essentially the same as in Option 2. The acreage requirement would be reduced from that of Option 1 by about 75 acres (220 to 145).

Potential impacts resulting from alluvial terrace extraction would increase in total and at an increasing rate over those resulting from Option 1. In addition, the annual extraction of 2,500,000 tons would represent an increase over the present extraction rate of about slightly more than 2,000,000 tons.

The potential impacts relating to changes in topography, groundwater levels and evaporation, loss of agricultural lands, the use of non-renewable resources, and the consumption of energy would be irreversible. The use of 1,073 acres of agricultural

lands would result in not only the loss of the soil resource, but also in the annual loss of almost 4,300 acre feet of groundwater to evaporation.

Other impacts associated with aggregate operations in the Middle Reach would also continue. Truck traffic, dust, noise, etc., would continue slightly above present levels, especially truck traffic, which fluctuates directly in proportion to material demand. Traffic through Windsor would increase unless an alternate route was developed.

Countywide energy consumption for 50 years under Option 3 would be 3.5 trillion Btu in processing fuel and 263.8 million kwh electricity. Transportation fuel use would be reduced due to the shorter haul distance from Healdsburg as opposed to the Alexander Valley.

Economic Impacts:

Employment in both the sand and gravel and hardrock industries would be similar to that of Option 2, that is, stable employment in sand and gravel and a slight drop in the labor force of hardrock operations.

Revenues from aggregate operations would be fairly constant from sales, equipment, and road taxes. Property tax revenues realized over the 50-year period would be about \$4,630,000 less than would be realized from the land had no mining occurred. Table V-9 shows the breakdown of property tax revenues under Option 3.

Supplies derived from the Middle Reach would generally be less expensive per ton than equivalent amounts from Alexander Valley instream sources due to the shorter haul distance. This advantage might be offset by increased costs due to the construction of an alternative haul route from the Middle Reach avoiding Windsor.

TABLE V-9: OPTION 3

PROPERTY TAX REVENUES

	ASSESSED VALUE PRIOR TO MINING	ASSESSED VALUE DURING MINING	ASSESSED VALUE AFTER MINING	CHANGE IN ASSESSED VALUE (Col. 1&3)	ACRES MINED	REVENUES
Terrace	\$6,000 (1)	\$6,000	\$200	\$5,800	1,073	-\$4,668,000 (3)
Instream (5)	200	1,000	200	-0-	400 (3 yrs.)	+ 36,000 (4)
Hardrock	500 (2)	500	200	300	145	- 1,305
TOTAL CHANGE						<u>- \$4,633,305</u>

(1) Vineyard and orchard

(2) Grazing land

(3) 3% tax rate and change in assessment occurs after 25 years

(4) \$1,000 for each acre for 3 years

(5) Skimming

1979 dollars and assessments

Producers of hardrock aggregates generally would not be expected to compete with sand and gravel producers in concrete, asphalt concrete, and road base markets due to raw material availability and higher processing costs. Many existing sites are too far from the major urban centers to have an advantage in haul costs. However, in the few cases where the quarry site has raw material and is close to market, the price would be comparable to more distant terrace sources with lower processing cost. Prices for subbase and fill materials would likely remain constant (1979 dollars).

Option 4: Supply and Demand

Option 4 relies heavily upon hardrock sources to supply all categories of aggregate use in Sonoma County. Instream gravels would be available as a supplemental supply at the "safe yield" or replenishment level. Terrace sources would be available for a three-year transition period only. Option 4 would necessitate the development of new quarry operations at a number of potential sites mapped in Section VI. Tables V-10 and V-11 show the relative percentages and tonnages supplied by each source for each use category under Option 4.

A fifty-year demand of almost 153 million tons from hardrock sources could not be supplied by existing quarry operations. Although total reserves at existing sites is about 135 million tons, only 34.5 million tons occur at sites which are large enough or have rock of adequate quality for use in concrete or asphalt. The remainder of the 100.5 million tons of reserves consists of rock which is of inconsistent quality or would require significant expansion of operations to produce those materials. As a result, the 100.5 million tons of non-specification reserves from these sites would be expected to continue to supply subbase, drain, fill, and some base materials (approximately 40 million tons). The primary existing sites (34.5 million tons) would be expected to contribute supply to the remaining demand of 112.8 million tons.

TABLE V-10

Use	Terrace	Instream	Hardrock
1. Concrete	14% ¹	10%	76%
2. Asphalt Concrete	--	--	100%
3. Base	--	--	100%
4. Subbase	--	--	100%
5. Bedding/Trench Backfill	--	10%	90%
6. Other Fill	--	--	100%
7. Drain Rock	--	--	100%
8. Other Uses ²	--	--	100%

¹Percentages are used to protect proprietary nature of supply information.

²Other uses may include some of the first 7 categories, if those products were only a small portion of a particular firm's business.

The shortfall of 78.3 million tons would be supplied by new operations at some of the potential sites mapped in this report or at other heretofore unknown sites. Assuming an average production of 250,000 tons per year per new site and an annual demand of 1.5 million tons (78.3 ÷ 50 years), at least six new

quarry sites with reserves in excess of 13 million tons each would be needed (see potential site reserves in Section II). In any case, the total of 152.8 million tons would require that approximately 651 acres be mined (247 by the year 2000).

A fifty-year supply of 6.2 million (2.3 million tons by the year 2000) tons from instream sources would be mined from the Russian River channel in Alexander Valley by the skimming method. Spread over a 50-year period, an annual extraction of 120,000 tons would meet the demand forecast. Extraction of bars would generally be limited to surface gravels which have built up to the point that streambanks are threatened by erosion, resulting in a small amount of removal per gravel bar, yet a large number of bars (1,685 acres) mined.

Alluvial terrace sources would supply aggregate at present levels (2 million tons per year) for a three-year transition period. A total of 6 million tons from 55 acres would be removed.

Material Suitability: (See Section III for a review of the suitability of each source for particular uses.)

Naturally rounded materials would be available in limited quantities from instream sources. Concrete made from fractured pieces would likely be less workable unless more water and cement were added. In addition, concrete and asphalt concrete uses would require more extensive crushing and washing to produce the required particle size and cleanness. Rounded particles for pipe bedding would be limited in availability. Instream sands would likely be the primary supply for this use, unless other supplemental sand sources were exploited. The use of pipe casing is also an alternative. Backfill materials would require some additional compaction in place.

Hardrock materials would be superior in quality to rounded aggregates for asphalt concrete, base, and

TABLE V-11: TONNAGES (IN MILLION TONS)

Use	Demand		Terrace		Instream		Hardrock	
	20 yr.	50 yr.	20 yr.	50 yr.	20 yr.	50 yr.	20 yr.	50 yr.
Concrete	16.5	43.7	6.0	6.0	1.7	4.4	8.8	33.3
Asphalt Concrete	7.8	20.6	--	--	--	--	7.8	20.6
Base	14.0	37.1	--	--	--	--	14.0	37.1
Subbase	7.8	20.5	--	--	--	--	7.8	20.5
Bedding/ Trench Backfill	6.9	18.3	--	--	0.6	1.8	6.3	16.5
Other Fill	1.5	4.1	--	--	--	--	1.5	4.1
Drain	1.7	4.5	--	--	--	--	1.7	4.5
Other Uses	6.1	6.2	--	--	--	--	6.1	16.2
TOTAL	62.3	165.0	6.0	6.0	2.3	6.2	54.0	152.8

subbase use due to the better interlocking of fragments and improved stability in place.

Environmental Impacts: (See Section IV for a review of potential impacts resulting from mining operations.)

Most of the potential impacts resulting from terrace

extraction operations would no longer occur after the three-year transition period. Truck traffic, noise, dust, loss of additional agricultural lands, further exposure of groundwater to evaporation and drawdown, etc., would cease. Some impacts resulting from the additional three years of extraction would continue beyond that period, however. Changes in topography and the 55 additional acres of lost agricultural land would not be reversed. Additional groundwater evaporation would amount to 220 acre feet per year. In-pit siltation would continue to inhibit groundwater movement through the mined areas.

Potential impacts resulting from instream extraction would be reduced from present levels and options relying more heavily on this source. Some flood control benefits would continue, but potential hydrologic impacts on bank stability, beach sand replenishment, channel downgrading, riparian vegetation, agricultural lands, bridge structure safety, and soil replenishment would likely occur, but to a lesser degree than is presently taking place. The decreased potential for hydrologic impacts on bank stability and channel downgrading also decrease the likelihood that impacts on the fishery habitat will occur. Furthermore, reduced supplies from Alexander Valley would likely decrease potential impacts related to the generation of truck traffic, noise, and dust.

However, Option 4, which disperses the inchannel supply among numerous gravel bars, would require access for trucks to many heretofore unmined locations. The development of these routes could result in either further loss of riparian vegetation, or potential water quality degradation from stream crossings, or both. This strategy would reduce the amount of traffic in any one location, but, at the same time, result in some traffic along different routes in the valley. The potential impacts on the quality of recreational opportunity along the river would be reduced overall. Mining activities on any one particular bar would likely occur at a reduced rate or for a shorter period of time during the year. However, more inci-

dences of contact between the recreational use and river mining activity might result from the extraction of a greater number of bars.

Potential impacts resulting from the 651 acres mined by hardrock operations would increase under Option 4. Adverse effects from existing operations, with the exception of the sites mentioned above, would continue at present levels (see Option 1), since no increase in rate of production would be expected.

Additional impacts resulting from the expanded operation of the primary sites might include increased groundwater use, increased noise and dust, increased emissions from batching plants, increased potential for water quality deterioration from batching operations, decreased visual quality, and increased energy consumption in processing operations.

Finally, the potential impacts resulting from the development of approximately six new quarry operations would affect new areas. The impacts would be similar to those of existing quarries, but truck traffic, traffic hazard, noise, dust, visual deterioration, vegetation removal, and other unavoidable impacts would occur in six new locations. Additional impacts could also occur. Processing operations would be more extensive and, combined with batching plants for concrete and asphalt, would increase potential impacts on air quality and noise. Also, the washing operation required for these uses could result in impacts on groundwater supply at the new sites.

Overall truck mileage and energy consumption would be slightly less on a Countywide basis. Transportation fuel could be reduced significantly compared to Option 1 due to reduced haul distances from hardrock deposits near to markets. Processing energy used will be: fuel, 4.5 trillion Btu; and electricity, 324 million kwh.

TABLE V-12: OPTION 4

PROPERTY TAX REVENUES

	ASSESSED VALUE PRIOR TO MINING	ASSESSED VALUE DURING MINING	ASSESSED VALUE AFTER MINING	CHANGE IN ASSESSED VALUE (Col. 1&3)	ACRES MINED	REVENUES (3)
Terrace	\$6,000 (1)	\$6,000	\$200	\$5,800	55	-\$ 9,570
Instream (5)	200	1,000	200	-0-	1,685 (4) (Assume \$1,000/ acre for 50 years)	+ 2,527,500
Quarry	500 (2)	500	200	300	651	- 5,859
TOTAL CHANGE						<u><u>+\$2,512,071</u></u>

(1) Vineyard and orchard

(2) Grazing land

(3) 3% tax rate and change in assessment occurs after 25 years

(4) \$1,000 for each acre for 3 years

(5) Skimming

1979 dollars and assessments

Economic Impacts:

Overall employment in the aggregate industry would increase on a per-ton basis. Employment reductions in sand and gravel operations will be less than increases in hardrock operations for the same tonnage produced. Approximately 40% of the added cost of processing hard rock compared to river rock for concrete is attributed to labor.

Revenues would likely remain constant from sales taxes since they depend on the amount of product sold. Equipment tax revenues would increase due to the added crushing equipment used by hardrock operations. Road taxes may be slightly reduced due to the reduction in haul distances Countywide. Property tax revenues would increase when compared to revenues generated by the same land unmined by over \$2.5 million.

Prices for concrete aggregate products at the hardrock plant would be about 25% greater due to increases in processing costs. Other products would increase in price to a lesser degree at the plant. However, these increases would likely be offset by price reductions due to shorter haul distances from hardrock sites generally closer in proximity to market areas. Aggregate products produced from instream sources would generally be less expensive at the extraction site but substantially more expensive than that from hardrock sources in delivered price. If supplemental sand is imported for some uses, an additional cost might result, depending on the distance and method of transport compared to the cost of crushing for sand. One quarry successfully imports sands by barge from the Bay delta region at a relatively low cost.

Option 5:

Under Option 5, future aggregate supplies would be derived from each of the three available source types--instream, terrace, and hardrock. The primary source of supply would be hardrock deposits.

Terrace deposits would make available rounded particles in quantities large enough to meet future demands for concrete aggregate. Instream aggregates would be available to a somewhat more limited degree as a supplemental supply similar to Option 4. Option 5 would also necessitate future hardrock quarry development at several new sites.

Tables V-13 and V-14 show the relative percentages and tonnages supplied by each source for each use category under Option 5.

A fifty-year demand in excess of 118 million tons from hardrock sources could be only partially met by existing quarry operations. As in Option 4, approximately 40 million tons of subbase, drain, fill, and some base materials would be available from most of the existing quarry sites. In addition, another estimated 34.5 million tons of base, backfill, and asphalt concrete materials would be available from existing primary sites. The burden of meeting the additional demand of 43.7 million tons would fall on new quarry operations. Spread over 50 years, slightly less than one million tons would be needed annually. Again assuming that the new operations average an output of 250,000 tons per year, at least four new sites would be necessary, each with reserves of approximately 11 million tons. Under Option 5, a combined total of about 502 acres (191 by the year 2000) would be mined from hardrock sources.

A fifty-year demand of almost 43 million tons from alluvial terrace sources would require a land commitment of about 382 acres (145 in 20 years). Annual extraction would average out to be slightly less than one million tons (860,000 tons per year), or approximately 45% of the current rate of extraction, but would vary mostly with the demand for concrete.

A fifty-year supply of four million tons from instream sources would be mined from the Alexander Valley portion of the Russian River. Using the skimming method of operation, annual extraction would total approxi-

TABLE V-13

Use	Terrace	Instream	Hardrock
1. Concrete	98% ¹	2%	--
2. Asphalt Concrete	--	--	100%
3. Base	--	--	100%
4. Subbase	--	--	100%
5. Bedding/Trench Backfill	--	17%	83%
6. Other Fill	--	--	100%
7. Drain Rock	--	--	100%
8. Other Uses ²	--	--	100%

¹ Percentages are used to protect proprietary nature of supply information.

² Other uses may include some of the first 7 categories, if those products were only a small portion of a particular firm's business.

mately 87,500 tons. As in Option 4, extraction would be spread over a number of bars, but limited in depth on each one, thus providing some protection for stream-banks threatened by lateral erosion.

TABLE V-14 : TONNAGES (IN MILLION TONS)

Use	Demand		Terrace		Instream		Hardrock	
	20 yr.	50 yr.	20 yr.	50 yr.	20 yr.	50 yr.	20 yr.	50 yr.
Concrete	16.5	43.7	16.2	42.8	0.3	0.9	--	--
Asphalt Concrete	7.8	20.6	--	--	--	--	7.8	20.6
Base	14.0	37.1	--	--	--	--	14.0	37.1
Subbase	7.8	20.5	--	--	--	--	7.8	20.5
Bedding/ Trench Backfill	6.9	18.3	--	--	1.2	3.1	5.7	15.2
Other Fill	1.5	4.1	--	--	--	--	1.5	4.1
Drain	1.7	4.5	--	--	--	--	1.7	4.5
Other Uses	6.1	16.1	--	--	--	--	6.1	16.1
TOTAL	62.3	165.0	16.2	42.8	1.5	4.0	44.6	118.2

Material Suitability: (See Section III for a review of the suitability of each source for particular uses.)

Under this option, naturally rounded particles would be available for use in Portland Cement Concrete. Instream gravels would also be available as a source of supplemental supply for both concrete and bedding aggregates. Hardrock sources would be available for the supply of crushed materials for asphalt concrete, road base and subbase, drain rock, fill and backfill aggregates. The use of other sources of imported sand may be an alternative to extensive crushing of hardrock for fine particles in asphalt concrete. The use of rounded terrace gravels would result in a workable concrete mix, with a lower water and cement requirement than one with crushed fragments. Bedding and trench backfill aggregates would need additional compaction in place with the use of crushed particles, but limited supplemental supplies of instream sands would be available.

Environmental Impacts: (See Section IV for a review of the potential impacts resulting from mining operations.)

Potential impacts resulting from instream extraction would be decreased due to the reduction in annual removal (800,000 tons per year to 87,500 tons per year) relative to present levels. This rate of extraction is much closer to the estimated replenishment of 60,000 tons per year in Alexander Valley. Mining in appropriate locations would permit continued flood control benefits to occur where inchannel buildup threatened banks. Potential impacts associated with river hydrology, beach sand replenishment, riparian vegetation, agricultural land, soil replenishment and bridge structure safety, would be decreased. Impacts relative to truck traffic, the quality of recreation opportunity, noise and dust generation, fish-

ery habitat, and water quality, would occur over a greater portion of the river environment, but would be decreased at each particular operation as described under Option 4.

Potential impacts resulting from terrace mining operations would also be decreased relative to present extraction levels. A total of 382 acres (145 by the year 2000) would be mined under this option, reducing annual extraction from over two million tons to less than 900,000 tons. Potential impacts on agricultural lands (382 acres lost), groundwater supply (over 1,528 acre feet evaporated) and movement and topography would continue but at a reduced rate. Energy consumption would be

Other unavoidable impacts would also continue to occur at a reduced rate (45%).

Potential impacts resulting from hardrock operations would be increased over present levels as in Option 4. A total of 502 acres would be mined (191 by 2000). Three levels of impacts which might occur are:

1. Continued impacts resulting from existing operations;
2. Additional impacts resulting from the expansion of some existing operations;
3. Additional impacts resulting from new operations.

Existing quarry operations which continue to supply the same materials at present rates of extraction would generate no additional impacts. Impacts resulting from the expansion of some quarry operations into the production of concrete, asphalt concrete, or base materials would include increased groundwater use, increased noise and dust from additional crushing operations, increased emissions from onsite batching plants, increased potential for water quality

deterioration from cement or oils, decreased visual/aesthetic quality, and increased energy consumption in processing operations.

Potential impacts resulting from four new operations would include all of those identified in Option 4 and in the above description of expanded quarry operations. These impacts would occur in presently unaffected areas and would be in addition to impacts from existing operations.

Total energy consumption for all operations under Option 5 would be as follows. Transportation fuel consumption may be reduced due to shorter haul distance from quarries closer to markets. Fuel used at the plant sites would be about 4.2 trillion Btu. Electricity consumption would be 306.5 kwh.

Economic Impact:

A reduction in supplies from instream and terrace sources would decrease employment in the sand and gravel industry. However, increased supplies from and employment in hard-rock operations would more than compensate for this loss since quarries generally employ a larger labor force on a per-ton basis. As a result, aggregate industry employment would be expected to increase Countywide. Employment in the trucking business, however, may suffer somewhat due to overall reductions in haul distance.

Sales tax revenues would be expected to remain constant for all options since the tax is based on sales only. Equipment tax revenues would increase overall due to the additional crushing facilities needed for hardrock operations. Road tax revenues may decrease slightly as haul distances shorten. Property tax revenues would be greater by about \$861,000 than revenues from the same land in an unmined state. Table V-15 shows the breakdown of these revenues by source (1979 dollars).

Prices for aggregate materials would likely remain the same (assuming 1979 dollars). Prices for concrete aggregates would not change since terrace operations would continue to supply that market. Asphalt concrete, road

base, and bedding and backfill products would be more expensive f.o.b. plant, but their closer proximity to delivery points would lower transportation costs and offset a possible price increase in delivered aggregate. Instream supplies would continue to be relatively inexpensive at extraction sites, but more costly to deliver from distant Alexander Valley to the urban centers. As in Option 4, the cost of using imported supplemental sand might compare favorably with additional crushing expenses for some operations, thereby affecting prices for particular operations.

Table V-16 summarizes the quantities of materials to be supplied by and the acreage required from each source for each management option considered.

Table V-17 compares the relative desirability of each management option according to eight (8) considerations:

1. The overall suitability of materials supplied for all uses.
2. Overall, the shortest distances required to deliver products to market.
3. The least impact on agriculture, in terms of acreage mined and the productivity of the soils.
4. The lowest acreage commitment for obtaining future supplies.
5. The least extensive processing required to supply all uses.
6. The greatest number of Countywide employees in the extraction and processing of aggregate materials.
7. The most revenues received from property taxes during the 50-year supply period.
8. The least significant overall environmental effects of mining operations.

TABLE V-15: OPTION 5

PROPERTY TAX REVENUES

	<u>ASSESSED VALUE PRIOR TO MINING</u>	<u>ASSESSED VALUE DURING MINING</u>	<u>ASSESSED VALUE AFTER MINING</u>	<u>CHANGE IN ASSESSED VALUE (Col. 1&3)</u>	<u>ACRES MINED</u>	<u>REVENUES (3)</u>
Terrace	\$6,000 (1)	\$6,000	\$200	\$5,800	382	-\$1,661,700
Instream (5)	200	1,000	200	-0-	1,685 (4)	+ 2,527,500
Quarry	500 (2)	500	200	300	502	- 4,518
TOTAL CHANGE						<u><u>+\$ 861,282</u></u>

(1) Vineyard and orchard

(2) Grazing land

(3) 3% tax rate and change in assessment occurs after 25 years

(4) \$1,000 for each acre for 3 years

(5) Skimming

1979 dollars and assessments

TABLE V-16

AGGREGATE DEMAND BY SOURCE FOR EACH OPTION

	OPTION 1		OPTION 2		OPTION 3		OPTION 4		OPTION 5	
	20 yr.	50 yr.	20 yr.	50 yr.	20 yr.	50 yr.	20 yr.	50 yr.	20 yr.	50 yr.
	<u>DEMAND (IN MILLION TONS)</u>									
Terrace	30.2	79.9	6.0	6.0	47.1	128.0	6.0	6.0	16.2	43.0
Instream	12.8	33.9	44.7	123.0	2.5	2.5	2.3	6.0	1.5	4.0
Hardrock	19.3	51.2	11.6	36.0	12.7	34.0	54.0	153.0	44.6	118.0
	<u>REQUIRED ACREAGE</u>									
Terrace	275	720	55	55	408	1,073	55	55	145	382
Instream *	660,000 tons per year		473	1,249	833,000 tons per year		120,000 tons per year		87,500 tons per year	
Hardrock	84	217	58	153	55	145	247	651	191	502

* For Options 1, 3, 4, 5 - Annual extraction rate is used in place of acreage since skimming is the preferred method of extraction.

The order of the criteria above and in Table V-17 does not necessarily reflect the relative importance of each factor. In addition, the ranking of options presented in the table is one of the bases upon which the proposed Management Plan is recommended.

TABLE V-17

COMPARISON^{*} OF
ALTERNATIVE MANAGEMENT OPTIONS

<u>CRITERIA</u>	<u>OPTIONS:</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
1. Material Suitability		3	5	4	2	1
2. Transportation		4	5	3	1	2
3. Agriculture		4	3	5	1	2
4. Land Commitment		3	5	4	1	2
5. Processing		2	3	1	5	4
6. Employment		3	4	5	1	2
7. Net Property Tax Revenues		4	3	5	1	2
8. Overall Environmental Impact		3	5	4	1	2
Total ^{**}		<u>26</u>	<u>33</u>	<u>31</u>	<u>13</u>	<u>17</u>

* The options are ranked in order from 1 to 5 for each of the eight criteria listed. 1 represents the most preferred and 5 the least preferred alternative in each case.

** The lower the total, the better the total rating for all eight criteria.

VI. PROPOSED MANAGEMENT PLAN

A. STUDY FINDINGS AND PLAN SELECTION CRITERIA

Major Findings

1. Aggregate Supply and Demand

- a. Adequate reserves of rock from each source are available within Sonoma County to supply estimated 50-year demand of 165 million tons.
- b. Both hardrock and alluvial sand and gravel are of sufficient quality to meet present specifications for most uses.
- c. Aggregate from hardrock sources must undergo more extensive processing on a per-ton basis than alluvial materials for some uses.
- d. Alluvial sources generally occur at a greater distance from most markets than potential hardrock sources, and their use usually results in more extensive hauling.
- e. Energy is consumed by all processing and hauling operations. Consumption per ton is relatively the same for delivered products when the hardrock source is approximately seven miles closer to market than the alluvial source.
- f. Total industry employment is increased per ton produced by the increased exploitation of hardrock sources.
- g. Both user specifications and project designs influence the type of products required and, therefore, the source of raw aggregate materials.

- h. The location of aggregate processing facilities in close proximity to extraction areas results in energy and transportation efficiencies. However, these facilities should be located at available industrial sites in the County rather than on stream channels, riparian lands, or flood plain soils.

2. Hydrology

- a. The lack of data and knowledge about the hydrologic consequences of instream mining necessitate a comprehensive monitoring system of hydrologic characteristics of the river channel.
- b. A computer bedload model (HEC-6) designed by the U. S. Army Corps of Engineers' Hydrologic Engineering Center has been evaluated and initially determined to be useful in monitoring the Russian River channel. A suggested monitoring program is included in Section VII
- c. Bedload replenishment in Dry Creek and the Middle Reach will be significantly reduced by the closure of Warm Springs Dam and continued use of Healdsburg Dam.
- d. Inchannel buildup of gravels in the Russian River in Alexander Valley threatens existing banks and farmlands in some locations.
- e. Streambed downgrading, increased gradient, and channel straightening and narrowing contribute to the increased erosive potential of floodwaters and thereby threaten bank vegetation and agricultural lands beyond the actual extraction area itself.
- f. Increased channel capacity provides some local reduction in flood elevations, but decreases the replenishment of flood plain soils.

3. Conservation

a. Hardrock operations

- 1) Riparian vegetation is threatened by direct removal by operations near streams.
- 2) Loss of such vegetation will reduce the available habitat for both terrestrial and aquatic animal species.
- 3) Streambed siltation which may result from the off-site discharge of sediments adversely affects aquatic species of animals.

b. Instream operations

- 1) Riparian vegetation is threatened by mining activities in several ways, including direct removal, accelerated streambank erosion, levee construction, and lowered groundwater levels.
- 2) Loss of such vegetation will reduce the available habitat for many diverse terrestrial and aquatic animal species.
- 3) Aquatic species of animals, particularly salmonids, are adversely affected by potential impacts of instream operations, including streambed siltation, riparian removal, destruction of pools and riffles, and the placement of instream crossings.
- 4) The loss of young riparian vegetation from gravel bars along the live summer channel will adversely affect the development of future mature riparian forest and result in a subsequent reduction in diversity of vegetation along the river.

- 5) A unique and important association of riparian plant species occurs in and adjacent to the stream channel from the vicinity of Gill Creek upstream to Asti in the Alexander Valley. As a result, this area is recommended for preservation.
- 6) Tributary streams to the Russian River, including Dry Creek, are important habitat for fish. In addition, the formation of pool habitats at their confluences with the main stem provides critical habitat for many species.

c. Terrace operations

- 1) Riparian vegetation is threatened by mining activities in several ways, including direct removal, accelerated streambank erosion, levee construction, and lowered groundwater levels.
- 2) Loss of such vegetation will reduce the available habitat for many diverse terrestrial and aquatic animal species.
- 3) Aquatic species of animals, particularly salmonids, are adversely affected by potential impacts of terrace operations, including streambed siltation and riparian removal, lowering of groundwater levels, levee failure, and placement of summer road crossings.
- 4) Unique associations of riparian plant species occur in three particular locations along the Russian River channel in the Middle Reach. As a result, these critical habitats are recommended for preservation.

4. Land Use

a. Hardrock operations

- 1) Mining of hardrock operations occasionally removes grazing land from production, but only in relatively small amounts.
- 2) In the case of some existing operations, recreational opportunity can be affected by hardrock mining.
- 3) Hardrock operations potentially conflict with residential uses in that they can result in noise, dust, truck traffic, and visual impacts.
- 4) Reclamation of hardrock operations is primarily concerned with reducing local, offsite impacts by drainage control, sloping and revegetation of cut surfaces.

b. Instream operations

- 1) Mining of instream gravels potentially conflicts with intensive agricultural uses along the stream channel due to bank erosion, bed downgrading, and loss in flood plain soil replenishment.
- 2) The quality of Russian River-oriented recreational opportunity is reduced by instream mining activities.
- 3) Instream operations potentially conflict with residential uses in some parts of the Russian River basin. Processing operations result in noise, dust, truck traffic and visual impacts.
- 4) Processing operations fixed within the stream channel have a potentially significant adverse effect on stream hydrology.

- 5) Reclamation of instream operations is an ongoing process. It should take place not only at the time that an operation is permanently concluded, but also at the end of each summer's extraction activities. Special attention must be given to bank protection in downgraded areas.

c. Terrace operations

- 1) Mining of flood plain terraces results in the direct removal of prime soils from intensive agricultural production.
- 2) Terrace operations potentially conflict with residential uses in the Middle Reach in that they generate noise, dust, truck traffic, and visual impacts.
- 3) Although terrace operations can reduce the quality of existing river-oriented recreation in the Middle Reach, reclamation of such operations offers an opportunity for recreational use of mined lands.
- 4) Potential future uses of terrace-mined lands, including recreation, agriculture, and wildlife conservation, involve significant restoration of riparian areas, the construction of channel and bank protection measures, and pit-slope erosion control.
- 5) The future use of terrace-mined lands for wildlife conservation allows restoration of the riparian habitat, while not precluding future development of the recreation use. The complete return of mined lands to agriculture use is not practical.

Proposed Plan: Selection Criteria

1. General Plan Goals and Policies

"General Goal on Future Planning and Development:

It shall be the goal of Sonoma County to accommodate population and land use changes by promoting a planning process that maintains and enhances the quality of life of its citizens."

"Policies

- e. preserve agricultural lands and encourage agriculture.
- f. use environmental suitability criteria to locate rural growth and guide urban growth
- h. plan with respect to Countywide and planning-area growth targets."

The goals and policies on land use related to economic concerns are:

- "1. It shall be the goal of Sonoma County to encourage diverse and stable economic growth

Policies:

- a. Provide a planning and regulatory climate that will preserve and stimulate agriculture and other natural-resource-based industries.
 - b. Direct public policy toward more self-sufficiency among the various communities.
2. It shall be the goal of Sonoma County to attract industries in order to reduce unemployment in the existing labor force.

Policies:

- c. Formulate a program designed to reduce unemployment to the average for the State.
- d. Encourage local sources of employment in order to reduce dependency on out-of-county commuting."

The goals and policies on Natural Resources contain subsections related to Historic and Archaeological sites, Recreation, Geologic Features and Hazards, Public Safety, Fire and Flood Hazards, Water Quality, Agriculture, Groundwater, Minerals, Fisheries, Water Resources, Plant and Animal Life, Scenic Resources, Soils, and others. Each of the above subsections pertains to the environmental assessment of mining operations in Sonoma County and to the selection of a management plan. However, most are too lengthy to be restated in this document. In addition, other elements of the General Plan, including Conservation, Open Space, Circulation, Air Quality, and Noise, address some of these concerns.

The Conservation element, for instance, states "Mineral exploration, mining, processing, and transportation sometimes conflict with other interests in the County. As a result, mineral resource operations need to be planned and conducted so as to avoid land-use conflicts".

"The General Goal on Natural Resources:

It shall be the goal of Sonoma County to identify natural resources that are of significant long-term social, economic, and environmental importance and to establish a comprehensive resource-management program in order that: these resources are managed for human benefit so as to avoid needless and careless depletion of the resource; the replenishment of renewable resources is promoted; the harvesting and use activities of individuals so engaged are directed towards

the most progressive and forward-thinking methods in these activities; the resources of the county are not damaged or lost through careless exploitation, and the needs of future generations for the use of the land and other resources are a paramount, compelling, and continuing consideration; short-term action will not irreparably limit future options; and developers are required to pay for the cost of resource extraction.

Policies:

- a. Determine the environmental suitability of land for specific types and intensities of use.
- b. Support and aid in studies of the ecological relationships among and within natural resources, managed resources, and human activity.
- c. Identify agencies at all levels of government that are involved with the regulation of managed resources; coordinate the implementation of related county goals and policies with these agencies.
- d. Continue to coordinate and evaluate land-use decisions and resource-management programs that involve the natural and managed resources of Sonoma County."

"J. Agriculture:

1. It shall be the goal of Sonoma County to protect and maintain agricultural land for the value of its products, its economic impact on the county, its contribution to community life, and its environmental values.

Policies:

- b. Support policies and programs providing tax and economic incentives that will

ensure the long-term retention of agricultural lands.

- d. Maintain and monitor major agricultural production areas, marginal production areas, and areas where production may be incompatible with residential and other land uses.
- g. Discourage residential use in agricultural areas unless the residential use can be shown not to conflict with agriculture."

"N. Minerals:

1. It shall be the goal of Sonoma County to provide for the comprehensive planning and restoration of mineral-extraction areas, such as sand-and-gravel deposits or quarries.

Policies:

- a. Consider inventories of mineral resources when planning or approving development.
- b. Discourage residential, commercial, or industrial development that would be incompatible with proper mining practices.
- c. Require that mineral-extraction operations be performed in a way that is compatible with surrounding land uses and minimizes adverse effects on the environment.
- d. Regulate sand-and-gravel extraction to ensure continuing replenishment of the supply.
- e. Consider the following when approving extraction: (i) preservation of topsoil and erosion control, (ii) preservation of natural vegetation, wildlife habitats, and fisheries, (iii) control of drainage and desilting basins, (iv)

provision for visual and noise control, (v) the condition and capacity of roadways, (vi) an engineering and geological survey, (vii) a restoration plan, (viii) bonds and liability commensurate with total costs of compliance with requirements imposed, (ix) inventories of sand and gravel and their replenishment, (x) recreational potential, (xi) air quality, and (xii) energy consumption."

2. Surface Mining and Reclamation Act (SMARA)

The findings of the California Legislature in relation to surface mining activities is contained in the General Provisions of the Act.

"Article 1. General Provisions

2711. (a) The Legislature hereby finds and declares that the extraction of minerals is essential to the continued economic well-being of the state and to the needs of the society, and that the reclamation of mined lands is necessary to prevent or minimize adverse effects on the environment and to protect the public health and safety.

(b) The Legislature further finds that the reclamation of mined lands as provided in this chapter will permit the continued mining of minerals and will provide for the protection and subsequent beneficial use of the mined and reclaimed land.

(c) The Legislature further finds that surface mining takes place in diverse areas where the geologic, topographic, climatic, biological, and social conditions are significantly different and that reclamation operations and the specifications therefor may vary accordingly.

2712. It is the intent of the Legislature to create and maintain an effective and comprehensive surface mining and reclamation policy with

regulation of surface mining operations so as to assure that:

(a) Adverse environmental effects are prevented or minimized and that mined lands are reclaimed to a usable condition which is readily adaptable for alternative land uses.

(b) The production and conservation of minerals are encouraged, while giving consideration to values relating to recreation, watershed, wildlife, range and forage, and aesthetic enjoyment.

(c) Residual hazards to the public health and safety are eliminated. . . ."

Based on these findings, the Act requires that the State Mining and Geology Board adopt a policy for surface mining and reclamation practice. In Special Publication 51 of April, 1977, the California Division of Mines and Geology published "State Policy for Surface Mining and Reclamation Practice". It contained an outline of the required elements of a reclamation plan, minimum acceptable reclamation practices, lead agency responsibilities, monitoring and review procedures, special provisions including vested rights, reclamation plan form, and a model ordinance for local agency compliance with SMARA.

The Act further requires that the State Geologist classify "urban and urbanizing portions of . . . areas within the state subject to urban expansion or other irreversible land uses" into one of three categories according to the presence or absence of mineral deposits. Geographic areas containing mineral deposits which may be of statewide or regional significance may be designated as such by the State Mining and Geology Board following a public hearing.

3. California Environmental Quality Act (CEQA)

The California Legislature passed in 1972 the

California Environmental Quality Act, which essentially required that the environmental consequences of proposed projects be considered prior to project approval. Article 3. Policy states:

"15010. Legislative Declaration. The Legislature has declared that:

(a) Every citizen has a responsibility to contribute to the preservation and enhancement of the environment.

(b) It is the intent of the Legislature that all agencies of the state government which regulate activities of private individuals, corporations, and public agencies which are found to affect the quality of the environment, shall regulate such activities so that major consideration is given to preventing environmental damage.

15011. State Policy. The Legislature has declared that it is the policy of the state to:

(a) Develop and maintain a high-quality environment now and in the future, and take all action necessary to protect, rehabilitate, and enhance the environmental quality of the state.

(b) Take all action necessary to provide the people of this state with clean air and water, enjoyment of aesthetic, natural, scenic, and historic environmental qualities, and freedom from excessive noise.

(c) Prevent the elimination of fish or wildlife species due to man's activities, insure that fish and wildlife populations do not drop below self-perpetuating levels, and preserve for future generations representations of all plant and animal communities and examples of the major periods of California history.

(d) Ensure that the long-term protection of the environment shall be the guiding criterion in public decisions.

(e) Create and maintain conditions under which

man and nature can exist in productive harmony to fulfill the social and economic requirements of present and future generations.

(f) Require governmental agencies at all levels to develop standards and procedures necessary to protect environmental quality.

(g) Require governmental agencies at all levels to consider qualitative factors as well as economic and technical factors and long-term benefits and costs, in addition to short-term benefits and costs and to consider alternatives to proposed actions affecting the environment.

15011.6. State Policies Regarding Use of Environmental Impact Reports. The Legislature has declared that the following policies shall apply to the use of environmental impact reports:

(a) The purpose of an environmental impact report is to identify the significant effects of a project on the environment, to identify alternatives to the project, and to indicate the manner in which such significant effects can be mitigated or avoided.

(b) Each public agency shall mitigate or avoid the significant effects on the environment of projects it approves or carries out to the extent it is feasible to do so.

(c) In the event that economic, social, technical, or other conditions make it infeasible to mitigate one or more significant effects of a project on the environment, such project may nonetheless be approved or carried out at the discretion of a public agency, provided that the project is otherwise permissible under applicable laws and regulations.

(d) Environmental impact reports should omit unnecessary descriptions of projects and emphasize feasible mitigation measures and alternatives to projects.

(e) Information developed in individual enviro-

onmental impact reports should be incorporated into a data base which can be used to reduce delay and duplication in preparation of later environmental impact reports.

(f) The EIR process is intended to enable public agencies in evaluating projects to determine whether a project may have a significant effect on the environment, to examine and institute methods of reducing adverse impacts, and to consider alternatives to a project as proposed. These steps of analysis and evaluation must be completed prior to approval of the project."

Later, Article 6 enables a public agency to prepare a master environmental assessment as a means by which information on a regional scale can be organized and formed into a data base, upon which environmental review of similar future projects can be based. Periodic review and update may be included as a part of the ongoing assessment.

4. State Policy on Agricultural Lands

A major criterion for plan selection is the potential impact of mining operations on agricultural lands. The findings of this study indicate that alluvial operations have a significant impact on flood plain soils and, as a result, intensive agricultural uses. The importance of prime agricultural lands is reflected in State policy. The Office of Planning and Research, in its report on Prime Agricultural Lands, states:

"Conversion of prime and potential prime agricultural land to other uses should not be permitted unless it is clearly demonstrated that, because of location or other characteristics, is infeasible to retain the land for agricultural use."

The policy is, therefore,

"(a) That the preservation of a maximum

amount of the limited supply of prime agricultural land is necessary to the conservation of the State's economic resources, and it is necessary not only to the maintenance of the agricultural economy of the State, but also for the assurance of adequate, healthful and nutritious food for future residents of this State and nation."

B. AGGREGATE USE PLAN

Based on the findings of this Study and criteria presented earlier in this section, the proposed management plan for aggregate resources is that described under Option No. 4 in Section V (Alternative Management Plans).

"Reliance upon hardrock sources for future supplies of all uses. Instream sources will be available for stream management purposes only. This option will include a three-year transition period for alluvial terrace operations."

The proposed plan calls for a "phase out" of alluvial terrace sources, a reduction in quantities mined from instream sources, and a substantial increase in the extraction of rock from existing and potential hard-rock sources.

Alluvial terrace operations will be permitted six million tons of reserves, enough to maintain current operations for three years, while new hardrock sources are developed. The Managed Resources/Open Space Map and the accompanying detail maps in Part C of this section show the areas which are recommended for mining in the Middle Reach during the transition period. Recommended operation and reclamation standards for these transition operations are included in Section VII and Appendix K.

Instream operations will be permitted to mine gravel bars in the Russian River in the Alexander Valley and the Middle Reach upstream of the Healdsburg Dam, according to standards detailed in Section VII. The areas proposed for mining are also shown on the Managed Resources/Open Space Map. No further instream mining will occur in either Dry Creek or the Russian River in the Middle Reach until future monitoring indicates the need for it. Existing operations in other streams in the County will be permitted under the same set of standards applicable to Russian River operations.

Hardrock sources, existing and potential, will supply over 150 million tons of aggregates during the next 50 years. Most existing sites are expected to produce subbase, drain, and fill materials due to the quality of particular deposits. A few existing sites will expand to produce concrete, asphalt concrete, backfill, etc. At least six new hardrock operations will be developed to produce concrete, asphalt concrete, base, backfill, and other materials. Existing sites are mapped in Part C of this section. Potential sites for development are described and mapped in detail in the technical report entitled, "Reconnaissance of Potential Hardrock Quarry Sites, Sonoma County, California", and supplemental maps prepared by staff. The map on page 205 shows the general location of these sites.

The suitability of each of the potential sites for future hardrock quarry development was determined according to several criteria. Several sites described in the technical report were excluded from immediate consideration because:

1. Site geology was not confirmed by direct field reconnaissance during either the existing or potential site surveys,

OR

2. The site was located in either a "devel-

opment" or "natural" area designated by the General Plan.

Some of these sites, listed below, may be suitable for development, but further geologic investigation is required to so verify.

1. Arrowhead Mountain
2. Lewis Creek
3. Stony Point Road
4. Forestville-Guerneville Road
5. Two St. Helena Road deposits
6. Mill Creek
7. Bradford Mountain
8. Cloverdale deposits
9. Grove Road
10. Trinity Road

The remaining sites are classified in one of three groups, depending on their suitability according to the following criteria:

1. Site reserves
2. Distance from markets
3. Compatibility of surrounding land uses (access included)
4. Environmental impacts

For each of the criteria, sites were rated as highly suitable (3 points), moderately suitable (2 points), or less suitable (1 point). Point totals for each site determined whether the site was designated as having primary, secondary, or tertiary potential.

It must be remembered that all of the sites listed have potential for quarry development. Although some with limited reserves, for example, are less suitable for larger operations, they may be well suited for a smaller scale quarry operation. Furthermore, large areas of potential resource were not field investigated by the study team due to limits on available funding. Some of these areas are immediately adjacent to identified deposits. Reserves for these sites may

TABLE VI-1

SITE	Deposit Size	Distance to Markets	Surround- ing Land Use	Environ- mental Impacts	Total
Kawana Springs	3	3	1	2	9
Sonoma Mountain Road	3	3	3	3	12
Roblar Road	3	3	3	3	12
Bailhache Avenue	3	2	3	2	10
English Hill	2	2	3	2	9
Cavedale/Goldstein	3	2	2	2	9
Van Buren Creek	3	1	2	2	8
Porter Creek Road	3	1	2	3	9
Pine Flat Road	3	1	3	3	10
Gird Creek Road	3	1	3	3	10
Buzzard Peak	3	3	1	2	9
Norrhom I and II	1	3	2	2	8
Wildcat Mountain I and II	2	2	3	2	9
Rodgers Creek	2	2	3	3	10
Highway 121	3	2	3	1	9
Walker Road	2	3	3	3	11
Leslie Road	2	2	2	2	8

Key

3 = Most suitable
 2 = Moderately suitable
 1 = Least suitable

6-8 = Tertiary
 9 = Secondary
 10+ = Primary

TABLE VI-1 (con't.)

SITE	Deposit Size	Distance to Markets	Surround- ing Land Use	Environ- mental Impacts	Total
Dutch Bill Creek	2	1	3	2	8
Champlin Creek	1	3	3	1	8
Alpine School	1	2	2	3	8
Felder Road	1	2	2	2	7
Fairville	1	2	3	2	8
Schocken Hill	1	3	1	2	7
Brooks Road	2	2	1	3	8
Warm Springs Road	1	2	1	2	6
Calabezas Creek	1	2	3	2	8
Nelligan Road	1	2	3	2	8
Lovall Valley Road	1	3	2	2	8
Beebe Ranch	1	3	3	3	10
Highway 121 North	1	2	3	2	8
Lynch Road	1	3	3	2	9
Hardin Lane	1	3	3	2	9
Western Avenue	1	3	1	2	7
Chalk Hill Road	1	2	2	2	7

Key

3 = Most suitable
 2 = Moderately suitable
 1 = Least suitable

6-8 = Tertiary
 9 = Secondary
 10+ = Primary

PRIMARY

- | | |
|-------------------------|--------------------|
| 1. Roblar Road | 5. Pine Flat Road |
| 2. Sonoma Mountain Road | 6. Gird Creek Road |
| 3. Walker Road | 7. Rodgers Creek |
| 4. Bailhache Avenue | 8. Beebe Ranch |

SECONDARY

- | | |
|------------------------|-------------------------------|
| 9. Kawana Springs | 14. Wildcat Mountain I and II |
| 10. English Hill | 15. Highway 121 |
| 11. Cavedale/Goldstein | 16. Lynch Road |
| 12. Porter Creek Road | 17. Hardin Lane |
| 13. Buzzard Peak | |

TERTIARY

- | | |
|----------------------|------------------------|
| 18. Van Buren Creek | 27. Brooks Road |
| 19. Norrbom I and II | 28. Warm Springs Road |
| 20. Leslie Road | 29. Calabezas Creek |
| 21. Dutch Bill Creek | 30. Nelligan Road |
| 22. Champlin Creek | 31. Lovall Valley Road |
| 23. Alpine School | 32. Highway 121 North |
| 24. Felder Road | 33. Western Avenue |
| 25. Fairville | 34. Chalk Hill Road |
| 26. Schocken Hill | |

be much greater than indicated. There may also be suitable deposits in many heretofore unconfirmed locations. In any case, the list of potential sites should not be considered as the sum total of all suitable hardrock sources in Sonoma County, but rather a selection of those sites which are in close proximity to major access routes or urban markets.

The Aggregate Use Plan specifies particular areas within the County which contain mineral deposits necessary for a future supply of aggregate materials. These areas are designated as "managed resource:

mineral" areas on the Resources and Undeveloped Areas Map of the Sonoma County General Plan.

That portion of the Alexander, Dry Creek, and Middle Reach Valleys containing mineral deposits not needed during the next 50 years has been designated as either "managed resource: agriculture" or "open space", recognizing both the importance of agricultural activities in the valleys and the natural sensitivities of the area without precluding future mineral resource extraction should it be necessary.

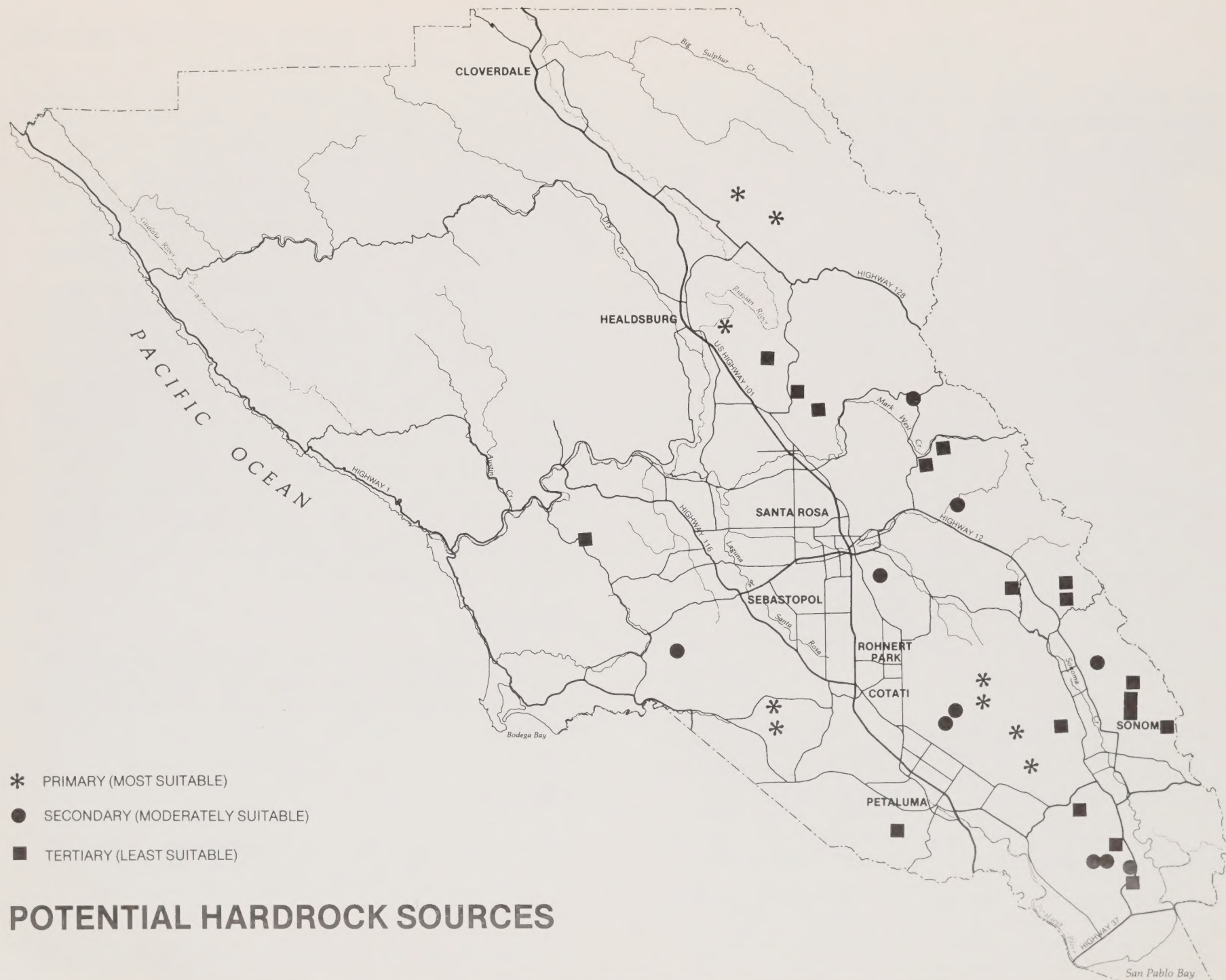
The Aggregate Use Plan also provides for a zoning district for all existing and future mineral operations and a procedure for processing use permit applications for future operations simultaneously with rezonings to the Mineral Resource (MR) District. The MR District is proposed in this plan and is included in Appendix G. Mining and reclamation standards which will apply to all mining operations are proposed as amendments to the County Surface Mining Ordinance (see Section VII and Appendix K.) The proposed plan includes a systematic monitoring program of aggregate mining operations. This monitoring program is described in more detail in Section VII (Management Process).

Circulation

Circulation alternatives are discussed and preferred routes are described for individual operations and extraction areas as the final piece of the Aggregate Use Plan.

Borrow Pits

1. Arfsten: Gossage Lane and Petaluma Boulevard North is the only access route to Highway 101 without entering downtown Petaluma.
2. Bohan & Canelis: Austin Creek Road or Cazadero



Highway to Highway 116 is the only route available.

3. Chenoweth and Green Valley: The main route follows Harrison Grade and Green Valley Roads to Highway 116 and markets to the east. Alternative routes to the south and north include Harrison Grade, Graton, and Green Valley Roads.
4. Ghilotti Brothers: Good access along either Stage Gulch Road or Lakeville Highway is available.
5. Graham: Graton and Harrison Grade Roads are available to the north. Graton Road is preferred for east-west hauls. Facendini Lane should be avoided in favor of the southern route through Occidental.
6. Hagemann and Transcentury: Both sites are adjacent to Highway 1 near coastal markets. Inland markets should be accessed via Bodega Highway or Petaluma-Valley Ford Road.
7. Passalacqua: Coleman Valley Road is the only route available. Connection to the east should be made with Graton Road; to the north with the Bohemian Highway.
8. Spaletta: Manor Lane is the only access route to Adobe Road east of Petaluma. Frates Road and Lakeville Highway will connect Adobe Road with U. S. 101. Manor Lane may require improvement.
9. Stage Gulch: Good access is available to all market areas via Highway 116.

Quarries

1. Bloomfield: Bloomfield Road is recommended for Sebastopol, Forestville, and Russian River markets. For access to urban markets along U. S. 101, an alternative route avoiding suburban Sebastopol is available via Canfield, Roblar, and Stony Point Roads.
2. Blue Rock and Canyon: Highway 116 is the preferred route available to the west and to the east as far as Forestville. It is recommended that the alternative routes (Mirabel Road to River Road and 116 through Forestville) be used interchangeably to avoid heavy truck traffic in downtown Forestville. Sebastopol, Rohnert Park, and other southern markets can be served by the Highway 116 route, while the northern County and Santa Rosa markets can be served by the Mirabel Road-River Road route. Martinelli Road east of Canyon Rock might be an occasional alternative for hauls to the Russian River area.
3. Brooks: Brooks Road is the only available access route to U. S. 101.
4. Cinnabar: Sweetwater Springs and Armstrong Woods Roads provide the only access between the site and Highway 116 in Guerneville. The preferred route for markets to the east is River Road from Guerneville rather than due east on Sweetwater Springs Road.
5. Inman: Wallace Creek and Mill Creek Roads are the only routes available to Westside Road near Healdsburg. From that point, Westside Road across Dry Creek and through Healdsburg is preferred.

6. Mark West: Petrified Forest Road is the only available route to Napa County.
The two alternative routes to Sonoma County markets, Porter Creek-Mark West Springs Roads and Calistoga Road would be used interchangeably depending on product destination. No alternative routes are available.
7. Nun's Canyon Trinity Road to Highway 12 is and Trinity: the only access route available.
8. Quarry Products, Inc.: Proximity to U. S. 101 enables immediate access to that route from Petaluma Boulevard South.
9. Sonoma Rock: Highway 121 (Arnold Drive) is the only available route.
10. Stony Point: Stony Point Road south to U. S. 101 and north to Highway 116 is the only route available.
11. Zamaroni: Petaluma Hill Road is the only access route to the north and south.
Kawana Springs Road and Yolanda Avenue are alternative connections to Santa Rosa Avenue and U. S. 101 to the east.

Middle Reach

Since terrace operations in the Middle Reach will be discontinued during the next three years, the use of existing routes is preferred. The levee/road along the west bank of the Russian River will continue to serve Basalt's operations at Dry Creek. Eastside Road and Windsor River Road will serve operations at Kaiser's south pit and the Quarry Products, Inc. site. Upon completion of the excavations at the recently permitted "Argonaut" parcel (R.M. #27.4), Kaiser Sand and Gravel truck traffic on Eastside

Road will be reduced by the location of future extraction near the south pit processing plant.

If terrace mining in the Middle Reach continues beyond the proposed three-year period, alternative access routes could be constructed which would enable the operations to continue without hauling loads through downtown Windsor. Shiloh Road presently extends west of the freeway for about 1.5 miles. An extension of 1.5 miles would intersect with Eastside Road just to the north of Kaiser's south pit. Such an extension, however, would be costly. Preliminary estimates of the Public Works Department place the expense at about \$500,000 to \$800,000 (1979 dollars) per mile depending on the structural section required (exclusive of costs for right-of-way acquisition of at least ten acres). There are also significant drainage problems associated with parts of the route.

A route south along Eastside Road and Trenton-Healdsburg Road to River Road is also feasible. Rebuilding of the bridge and upgrading of the two roads to accommodate trucks might be accomplished for less than \$1.5 million. A possibility exists for obtaining 80% federal funding of the rebuilding of the bridge and its approaches. At the present time, the bridge project and a minor upgrading of the two roads is projected for fiscal year 1982-83, but no funding has yet been approved. The additional upgrading to accommodate gravel trucks would only increase the road work cost by 10-15%.

Alexander Valley

Future instream extraction in the Alexander Valley is dependent on access to a number of inchannel gravel bars. U. S. 101 and Highway 128 provide access along each side of the river for much of its length, but connections are needed between the freeway and particular gravel bars. Three alternatives are available:

1. Access routes directly from frontage roads to each bar through existing agricultural lands, or
2. Access to the channel at permanent or temporary bridges with culverted stream crossings between bars, or
3. Access via haul road levees adjacent to the channel similar to the west bank levee in the Middle Reach.

The preferred alternative is a combination of the three. Potential connecting routes to the channel are located at periodic intervals along the river's length (see Hydrology Map, Section II for River Mile locations).

1. East Soda Rock Lane (R.M. #44.8)
2. Alexander Valley Road Bridge (R.M. #46)
3. South of Gird Creek from Highway 128 (R.M. #48)
4. The Cadd-Drake property access from Highway 128 presently used by H. Groom, Inc.
5. East of the U. S. 101 Geyserville interchange (south) (R.M. #50.9)
6. Highway 128 Bridge (R.M. #52)
7. East of the U. S. 101 Geyserville interchange (north) (R.M. #53.0 and 53.9)
8. Cloverdale Airport
9. Crocker Road Bridge and east bank levee

Access to bars between these connecting routes will be available via stream crossings constructed according to Regional Water Quality Control Board standards included in Section VII. In some locations, an ex-

isting levee might provide a haul route along the channel, thereby reducing the necessity for stream crossings. The circulation plan for aggregate materials in the Alexander Valley would also be appropriate for rail hauls, since the Northwestern Pacific Railroad line parallels the Russian River and U. S. 101 through the valley.

C. MANAGED RESOURCES/OPEN SPACE PLAN

The Managed Resources/Open Space (MR/OS) Plan supports and complements the Aggregate Use Plan. In fact, the preservation of natural resources within the Study area was a primary concern in the development of the Aggregate Use Plan. The MR/OS plan is shown on the accompanying maps and includes the following areas:

1. Managed Resource: Mineral

All mineral resource deposits in Sonoma County necessary for a future supply of aggregate materials are included within this category. Existing hard-rock quarries are shown on topographic maps on ensuing pages. Terrace and instream sources are shown on either the Managed Resources/Open Space maps or one of the subsequent detailed maps, or both. Potential hardrock sources are mapped in the technical report entitled, "Reconnaissance of Potential Hardrock Quarry Sites, Sonoma County, California" and supplemental maps prepared by staff. These areas will be shown as "Managed Resources" on the Resources and Undeveloped Areas map of the Sonoma County General Plan.

2. Managed Resource: Agriculture

All lands overlying mineral resource deposits within the Study area which are proposed for preservation for their value as both an agricultural resource and as groundwater recharge. Agricultural lands not overlying mineral resource deposits are not included in this mapped category. See Section



Russian River, Alexander Valley Cloverdale Section Map A-1 **MANAGED RESOURCES/ OPEN SPACE**

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
0 900 1800 Meters

Match Line Map A-1



Match Line Map A-3



STREAM



MANAGED RESOURCE: MINERAL



RIPARIAN VEGETATION



MANAGED RESOURCE: AGRICULTURE



OPEN SPACE: RIPARIAN CORRIDOR



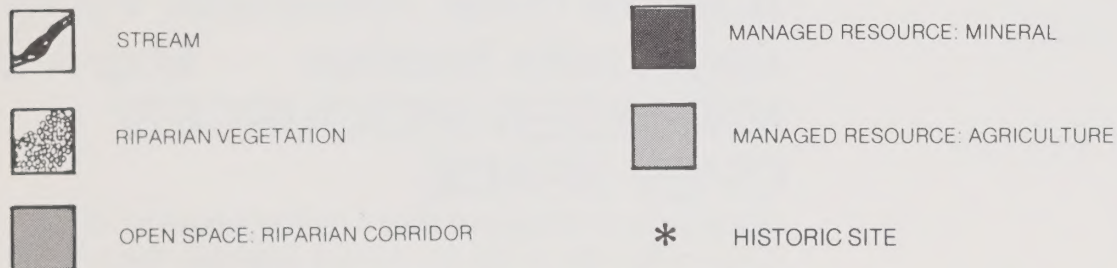
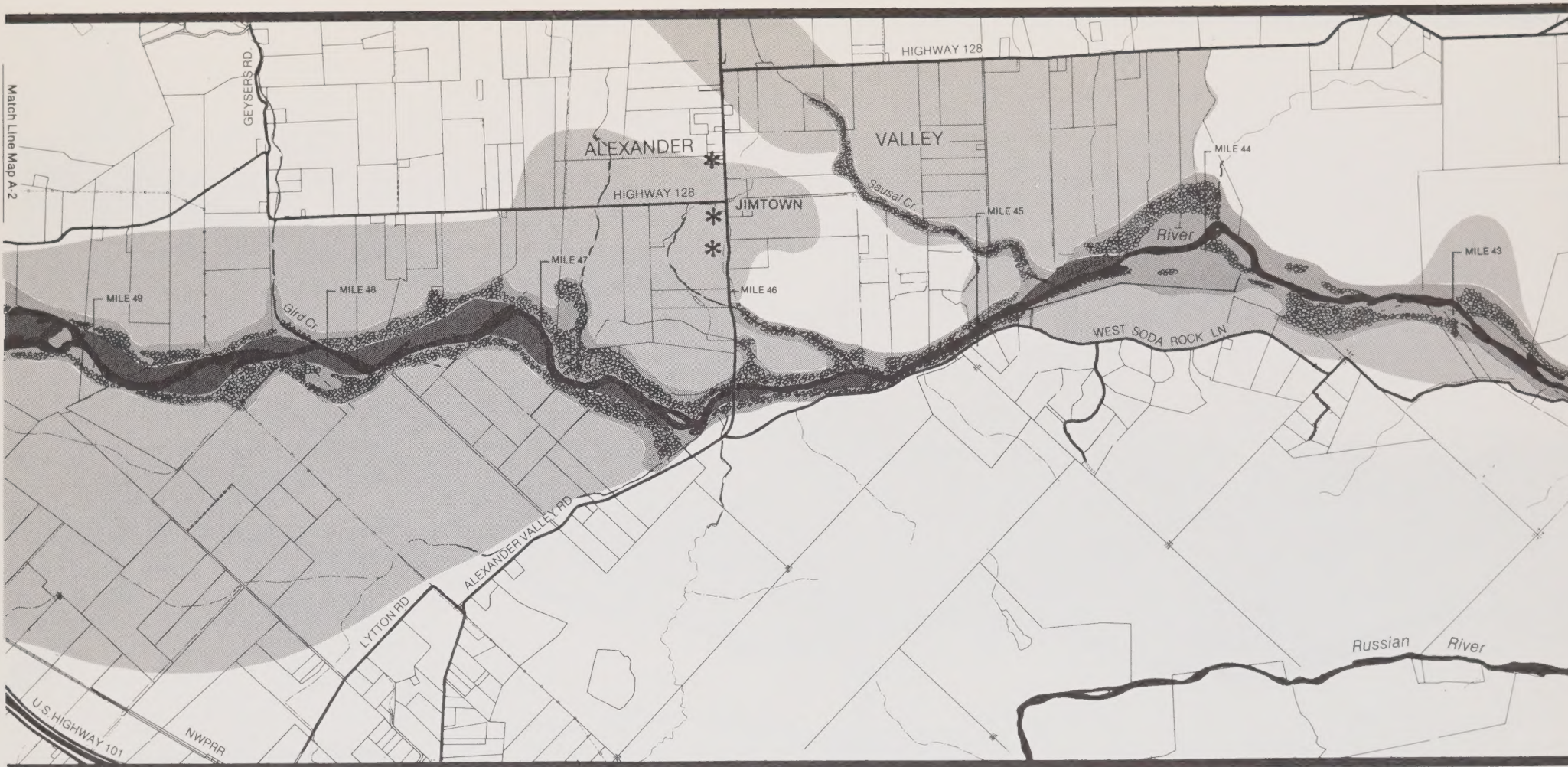
DEVELOPED: URBAN

Russian River, Alexander Valley Geyserville Section Map A-2 MANAGED RESOURCES/ OPEN SPACE

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
0 900 1800 Meters

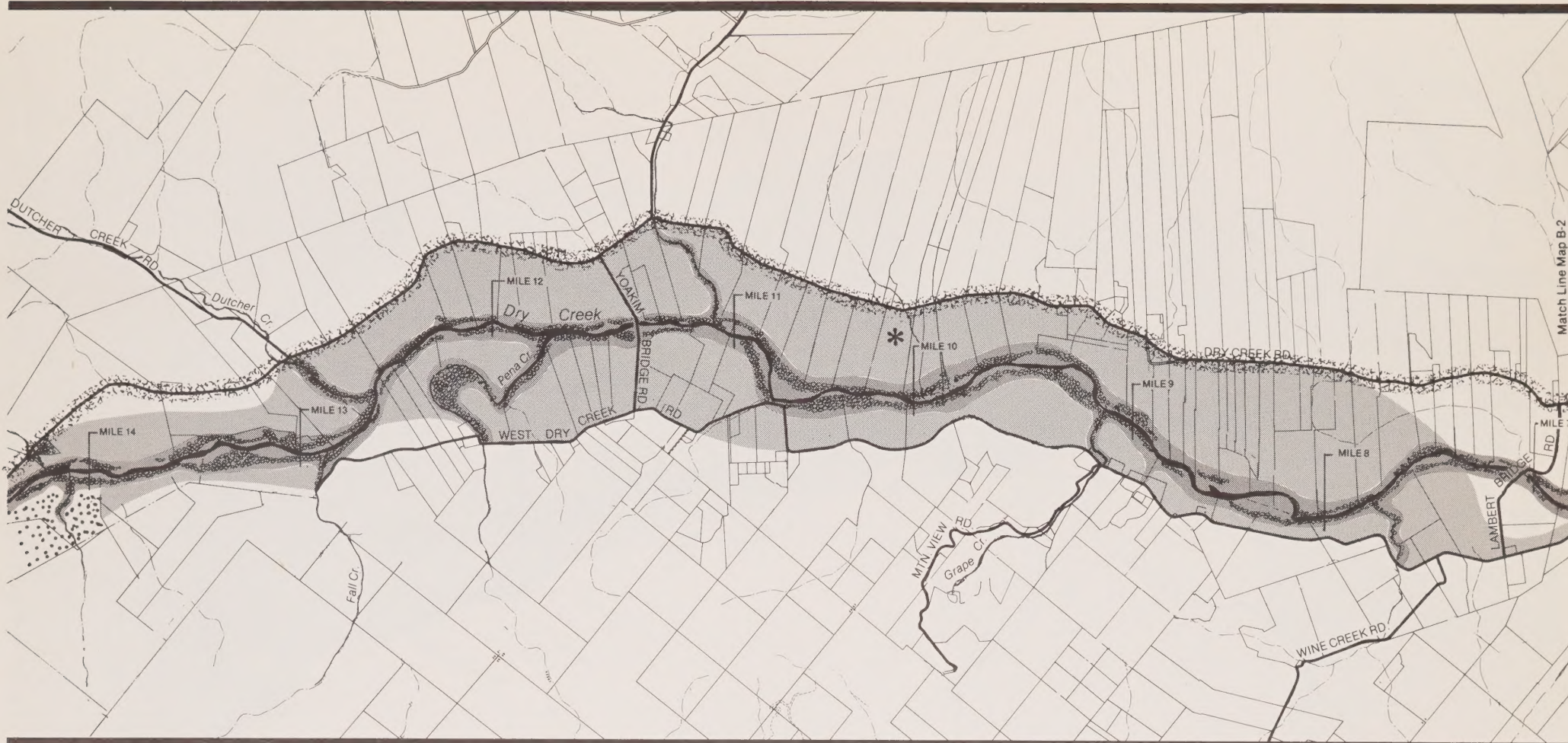


Russian River, Alexander Valley Jimtown Section Map A-3 **MANAGED RESOURCES/ OPEN SPACE**

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



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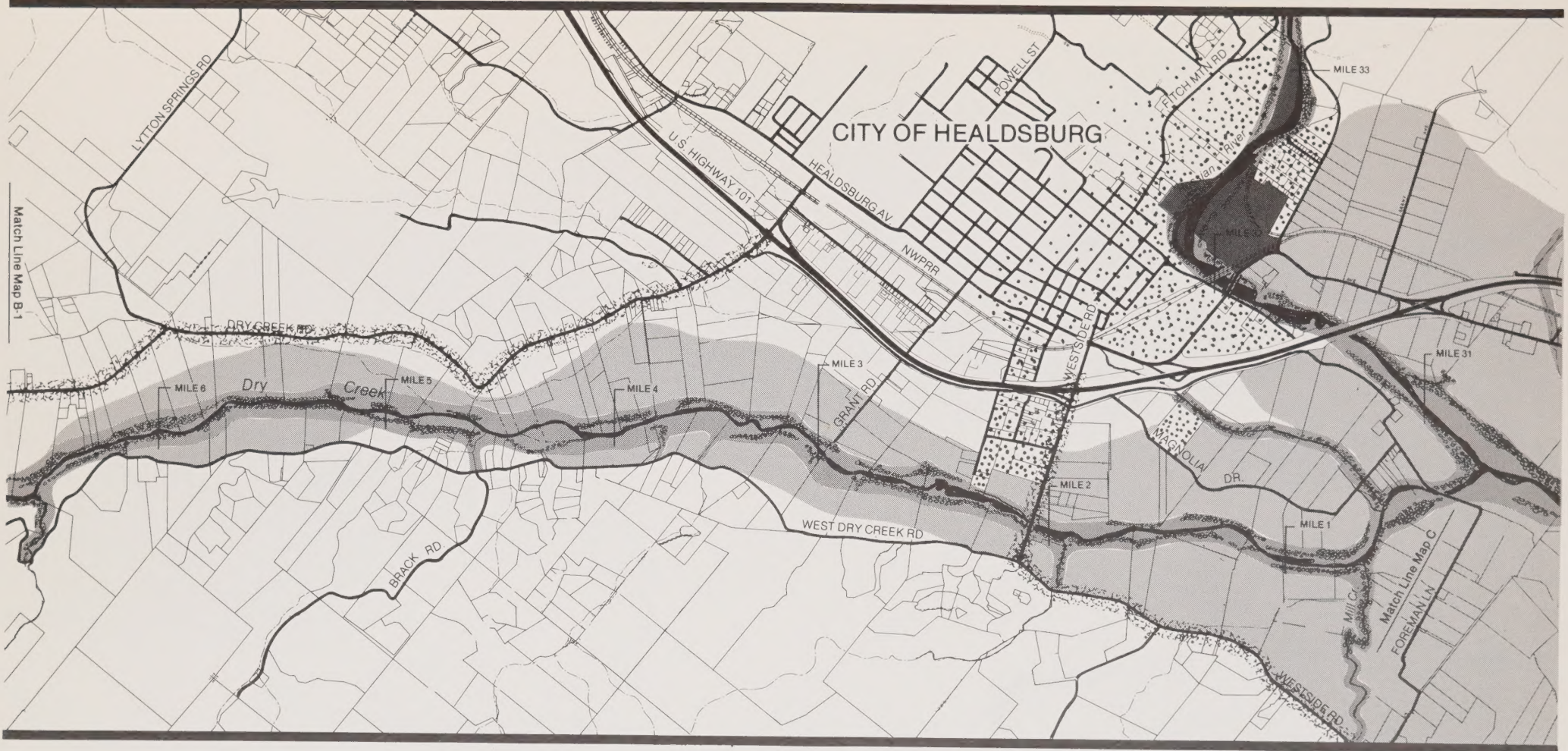
Dry Creek, Dry Creek Valley Yoakum Bridge Section Map B-1 MANAGED RESOURCES/ OPEN SPACE

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
0 900 1800 Meters

Match Line Map B-2



- | | | | |
|--|-------------------------------|---|-------------------------------|
|  | STREAM |  | MANAGED RESOURCE: MINERAL |
|  | RIPARIAN VEGETATION |  | MANAGED RESOURCE: AGRICULTURE |
|  | OPEN SPACE: RIPARIAN CORRIDOR |  | DEVELOPED: URBAN |
| | |  | SCENIC ROUTE |

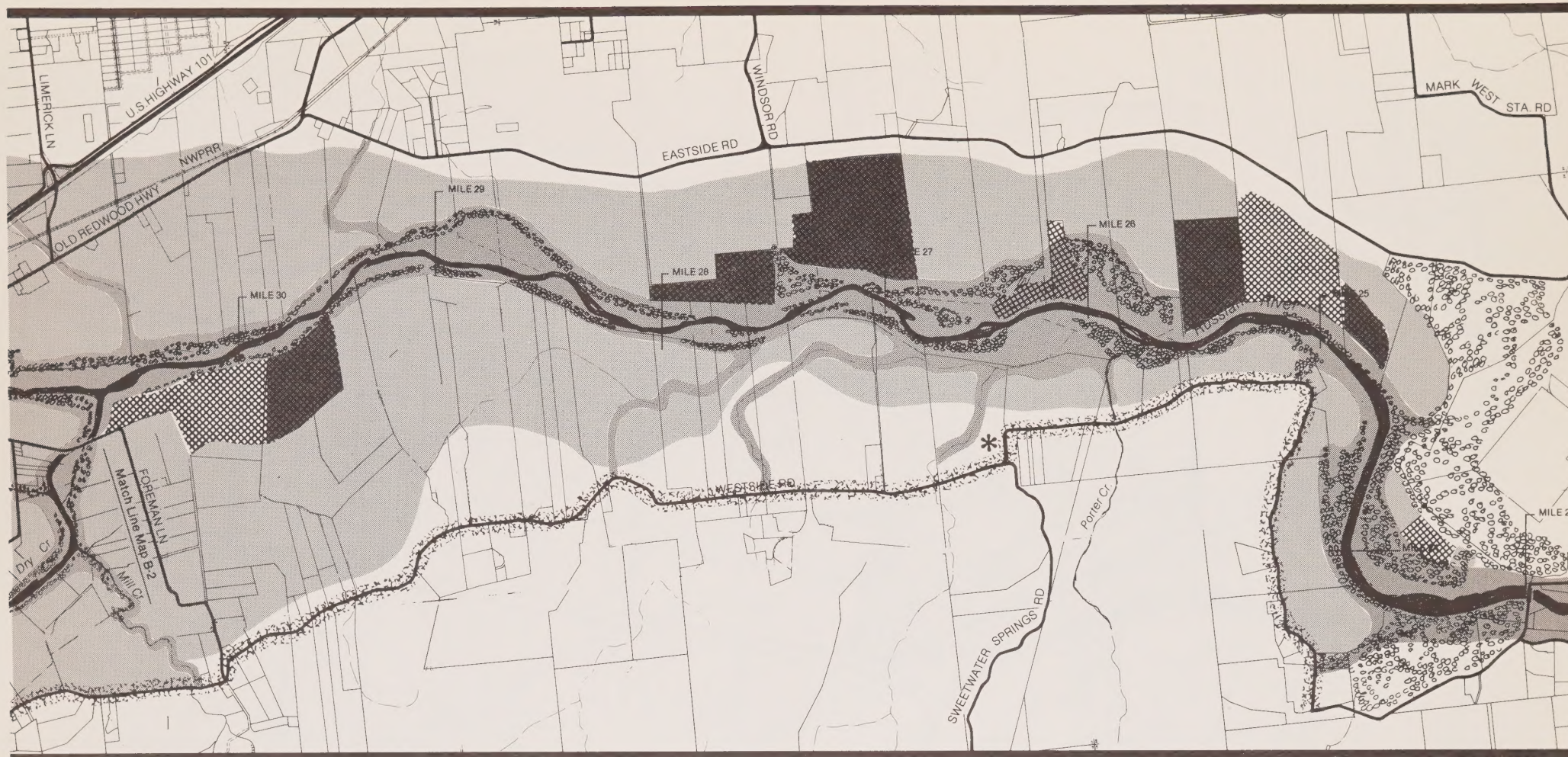
Dry Creek, Dry Creek Valley Healdsburg Section Map B-2

MANAGED RESOURCES/ OPEN SPACE

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
0 900 1800 Meters



STREAM



MANAGED RESOURCE: MINERAL



RIPARIAN VEGETATION



MANAGED RESOURCE: AGRICULTURE



OPEN SPACE: RIPARIAN CORRIDOR



SCENIC ROUTE



RECLAMATION



HISTORIC SITE

Russian River, Middle Reach Map C

MANAGED RESOURCES/ OPEN SPACE

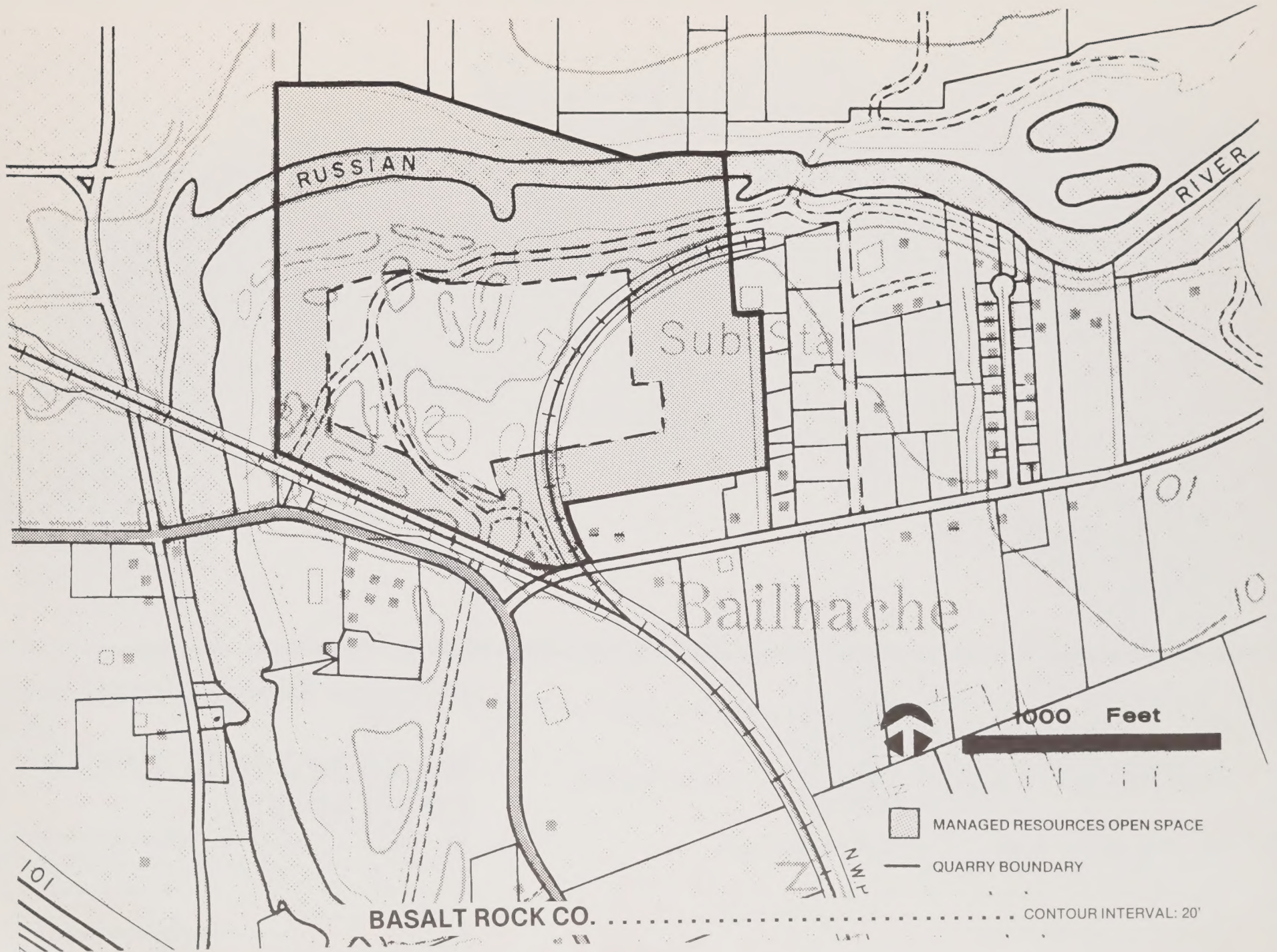
Aggregate Resources Management Study
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Planning Division, Sonoma County Calif.

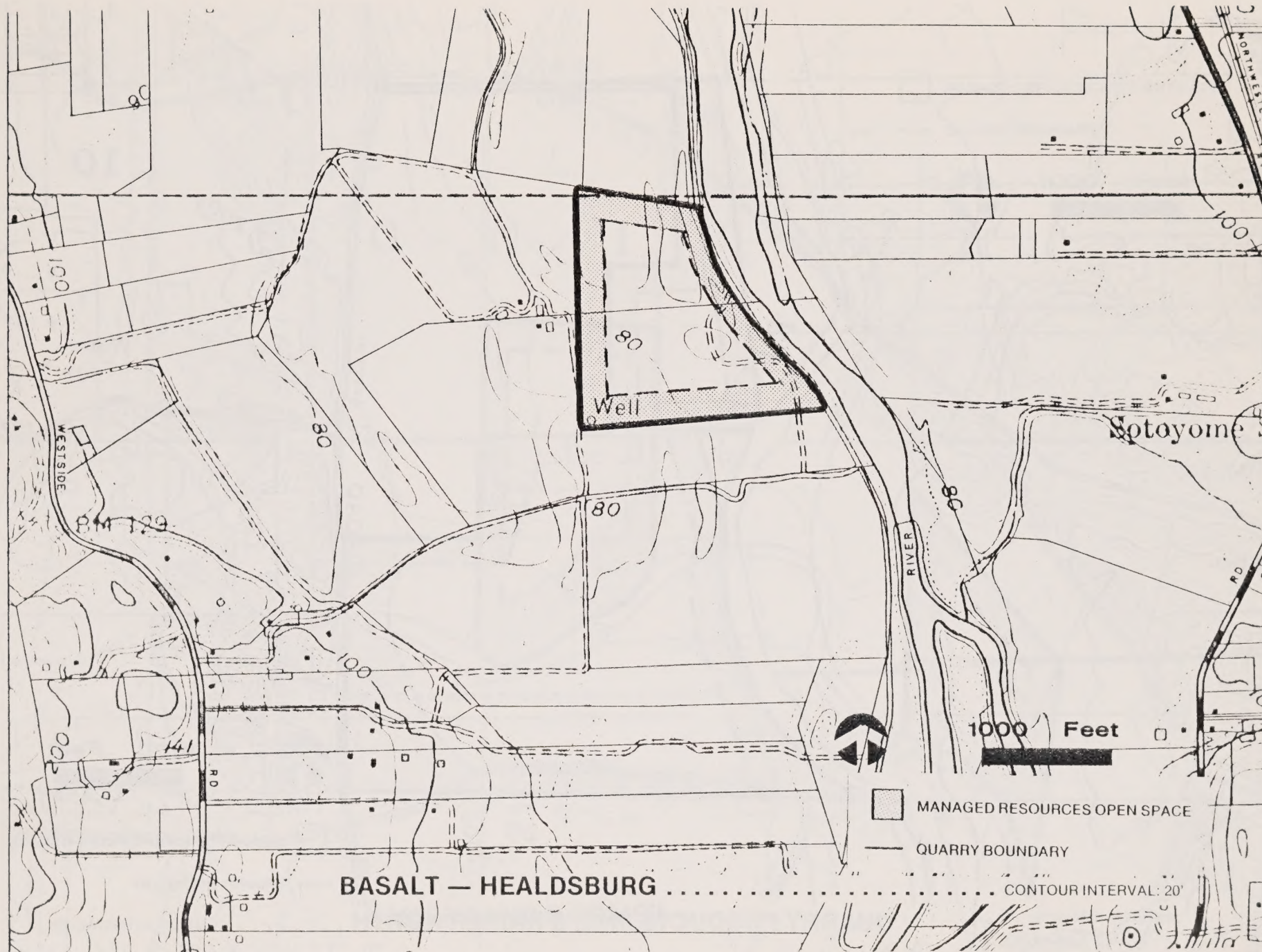


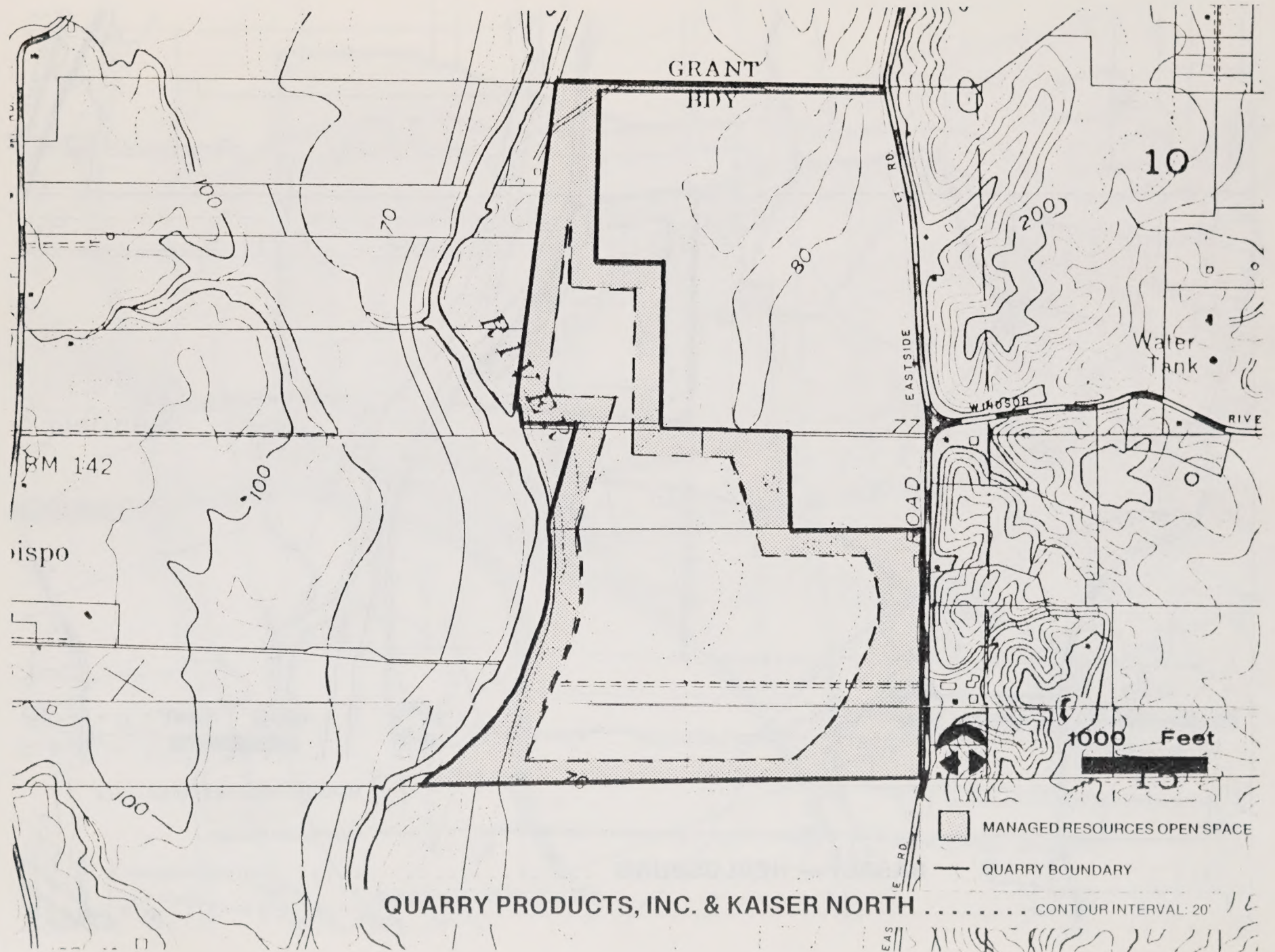
North

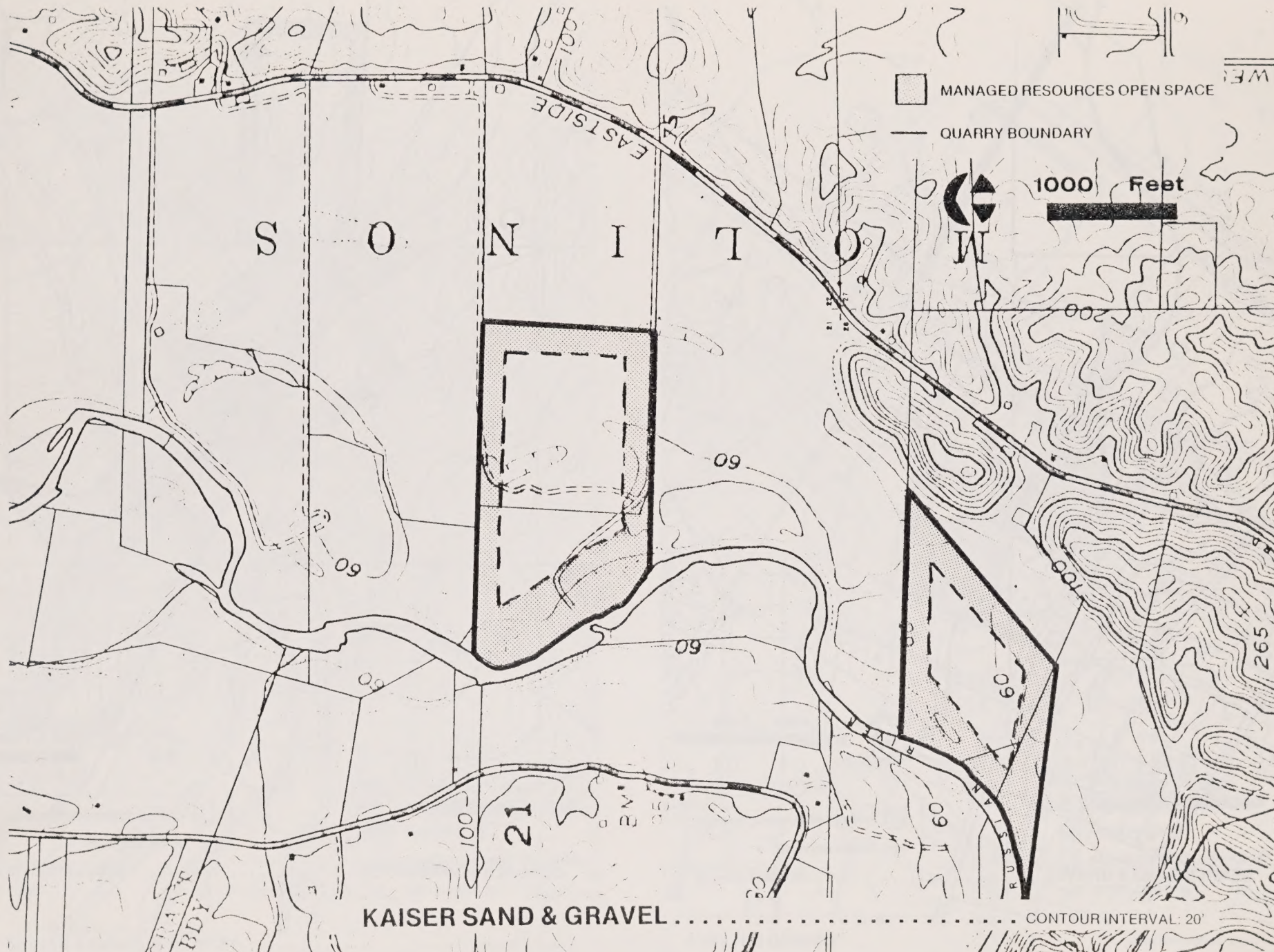
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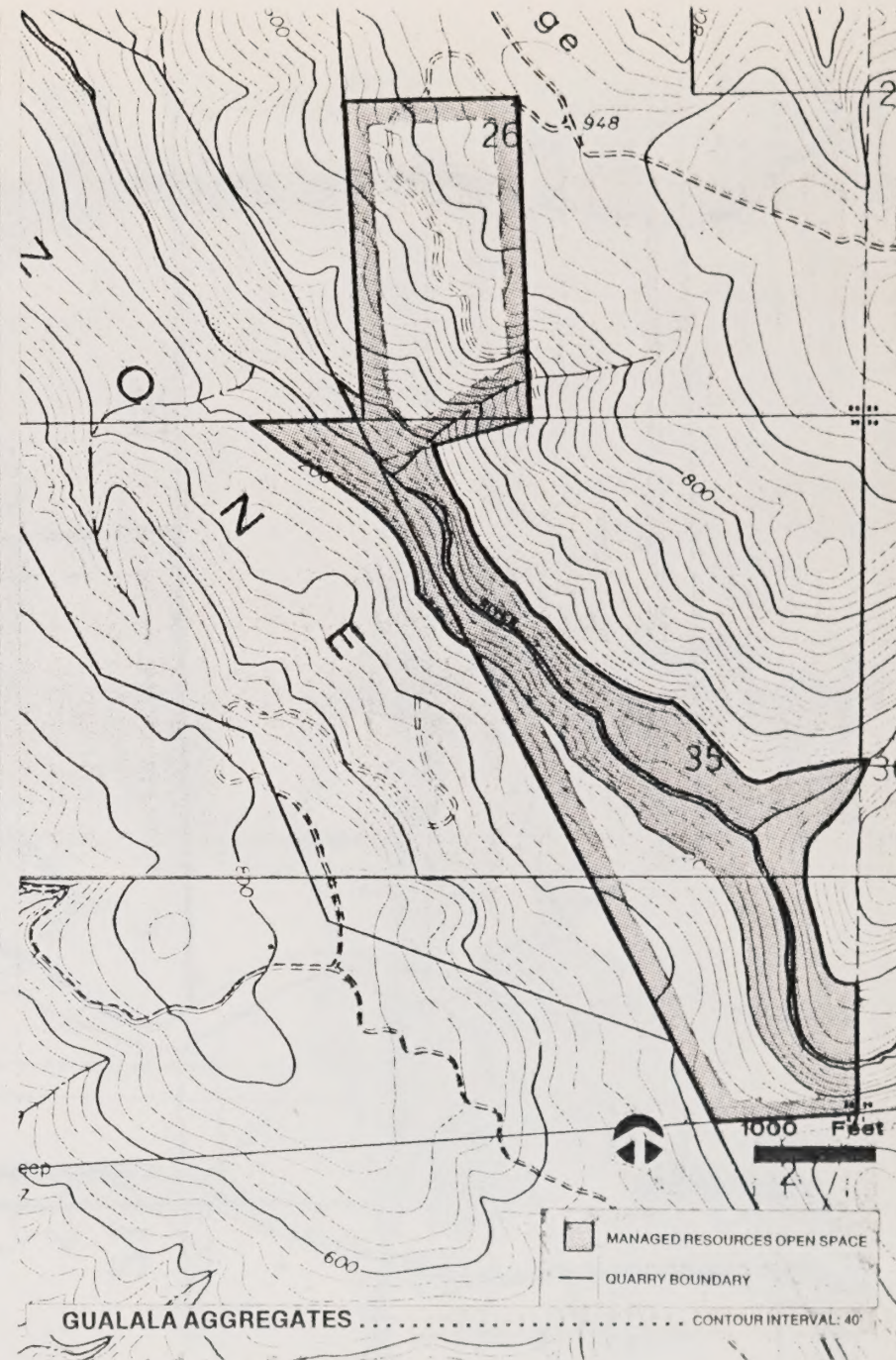
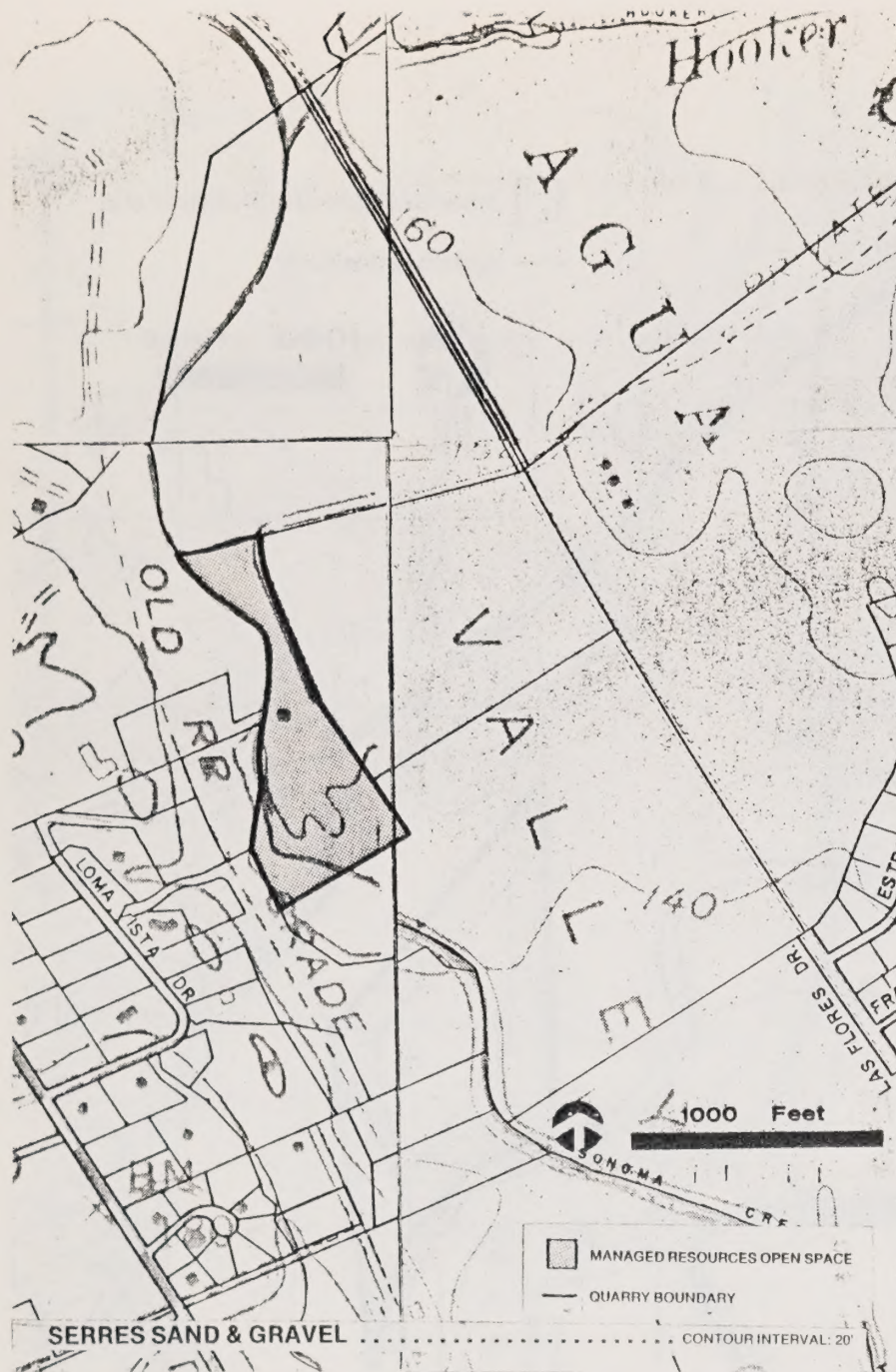
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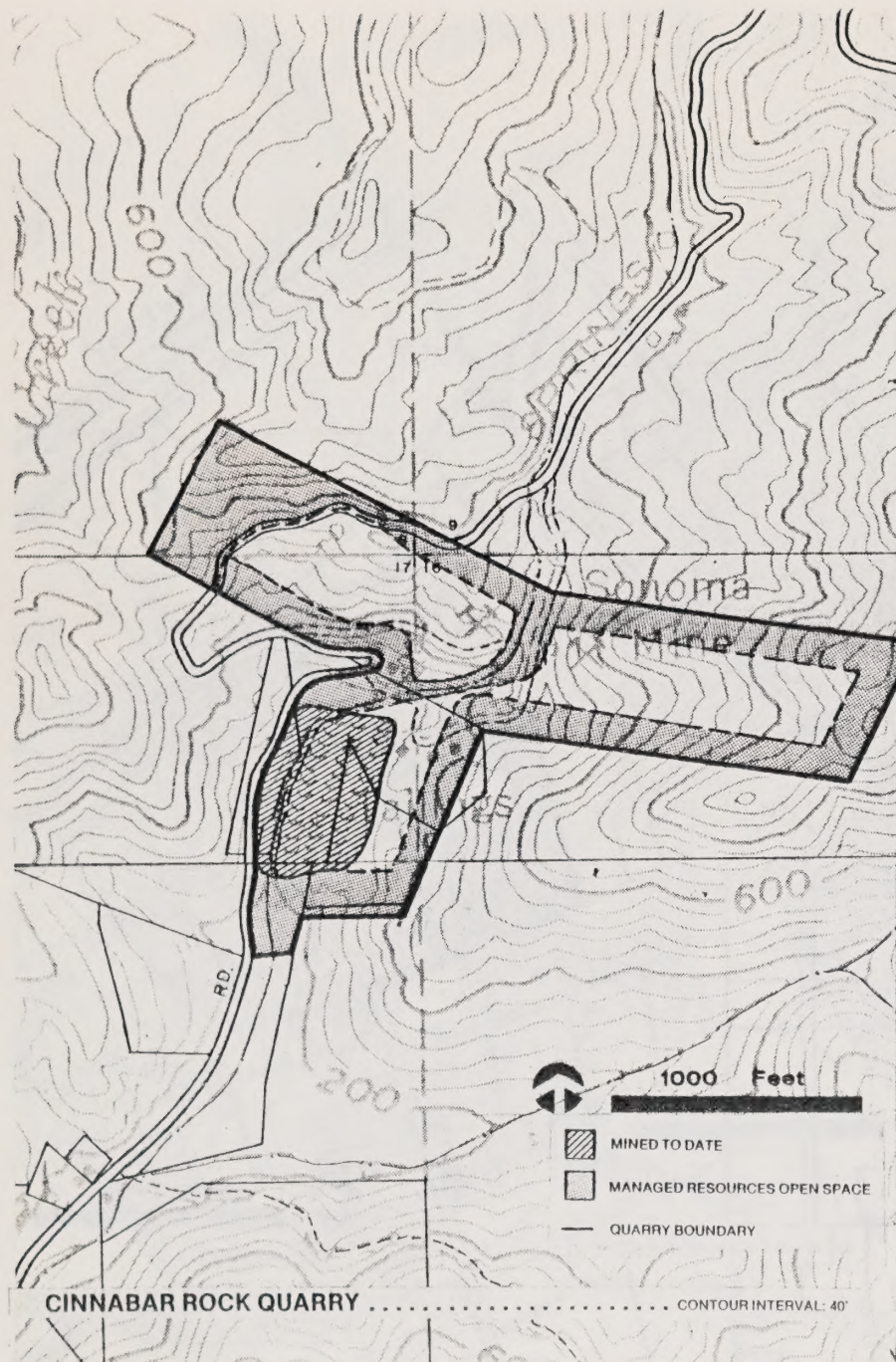


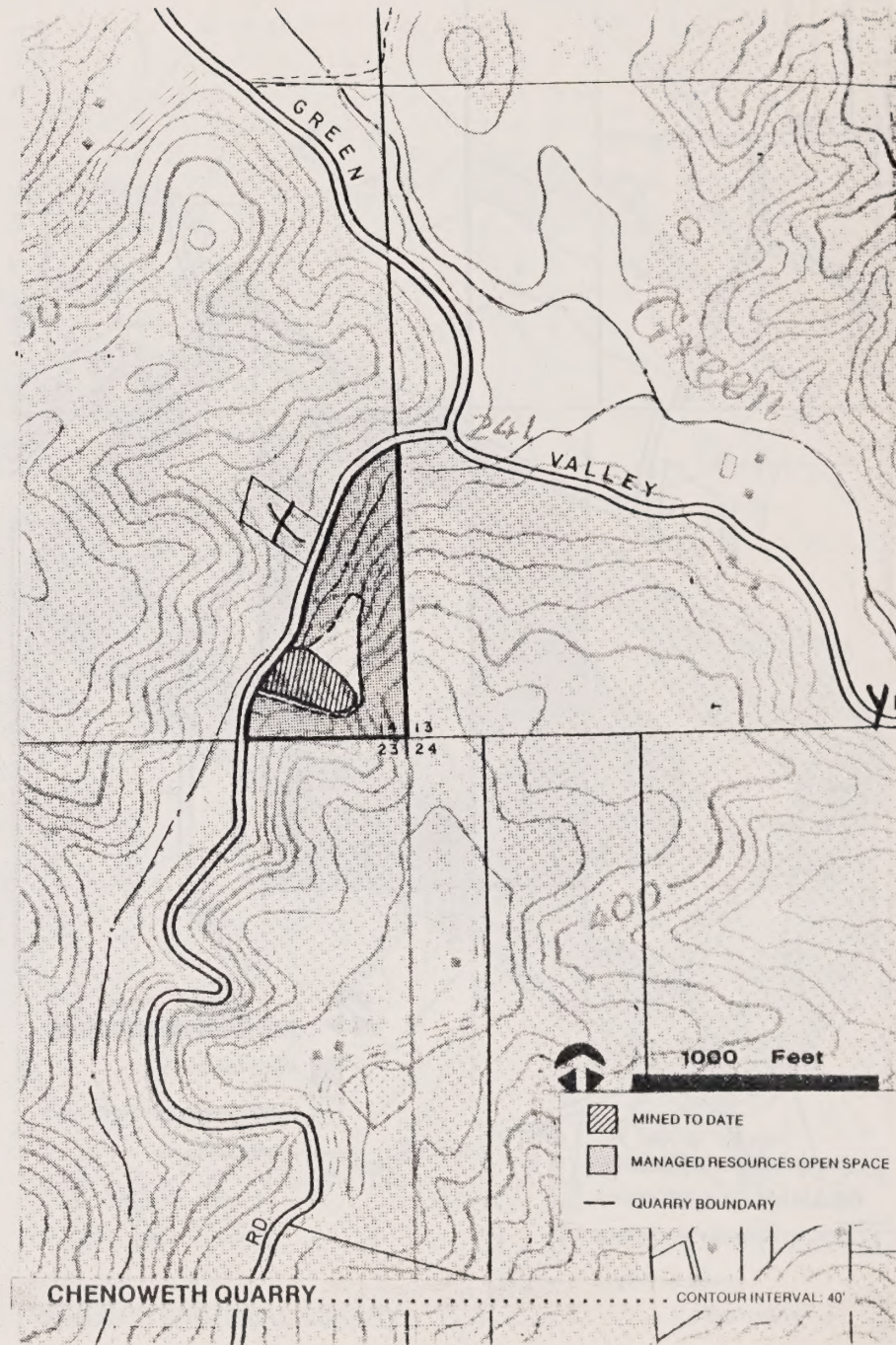
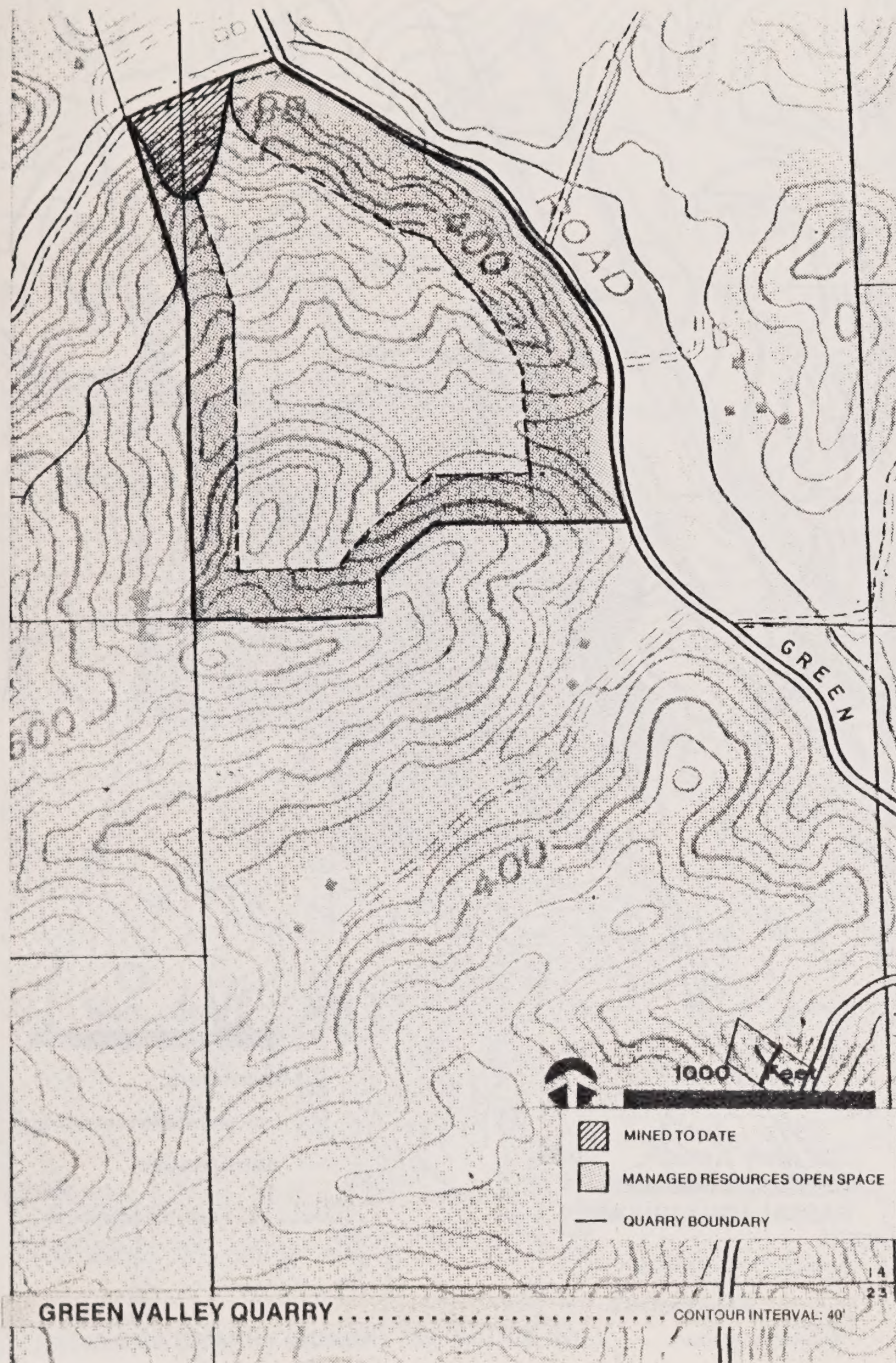


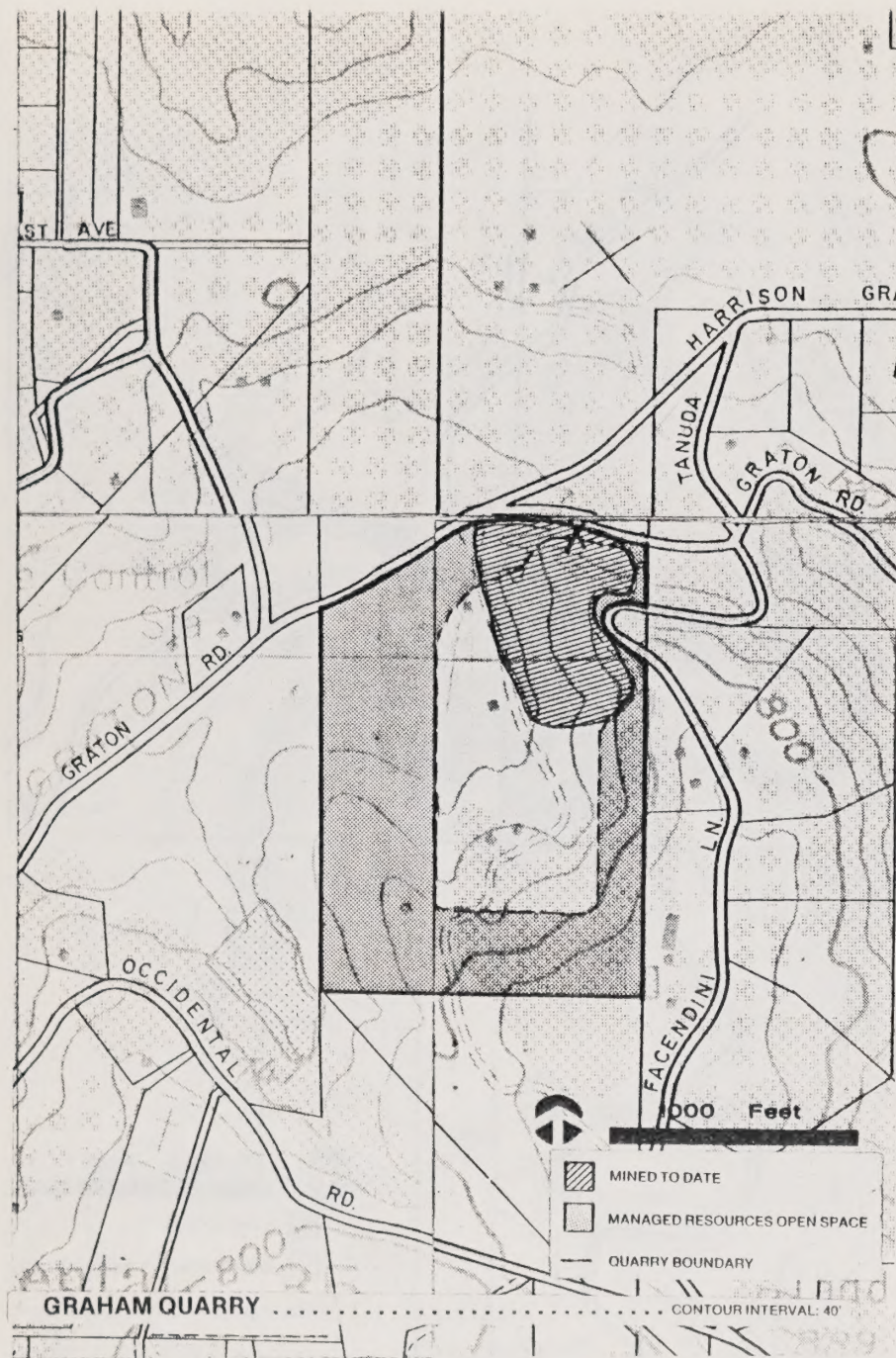
BOHAN & CANELIS QUARRY CONTOUR INTERVAL: 25'

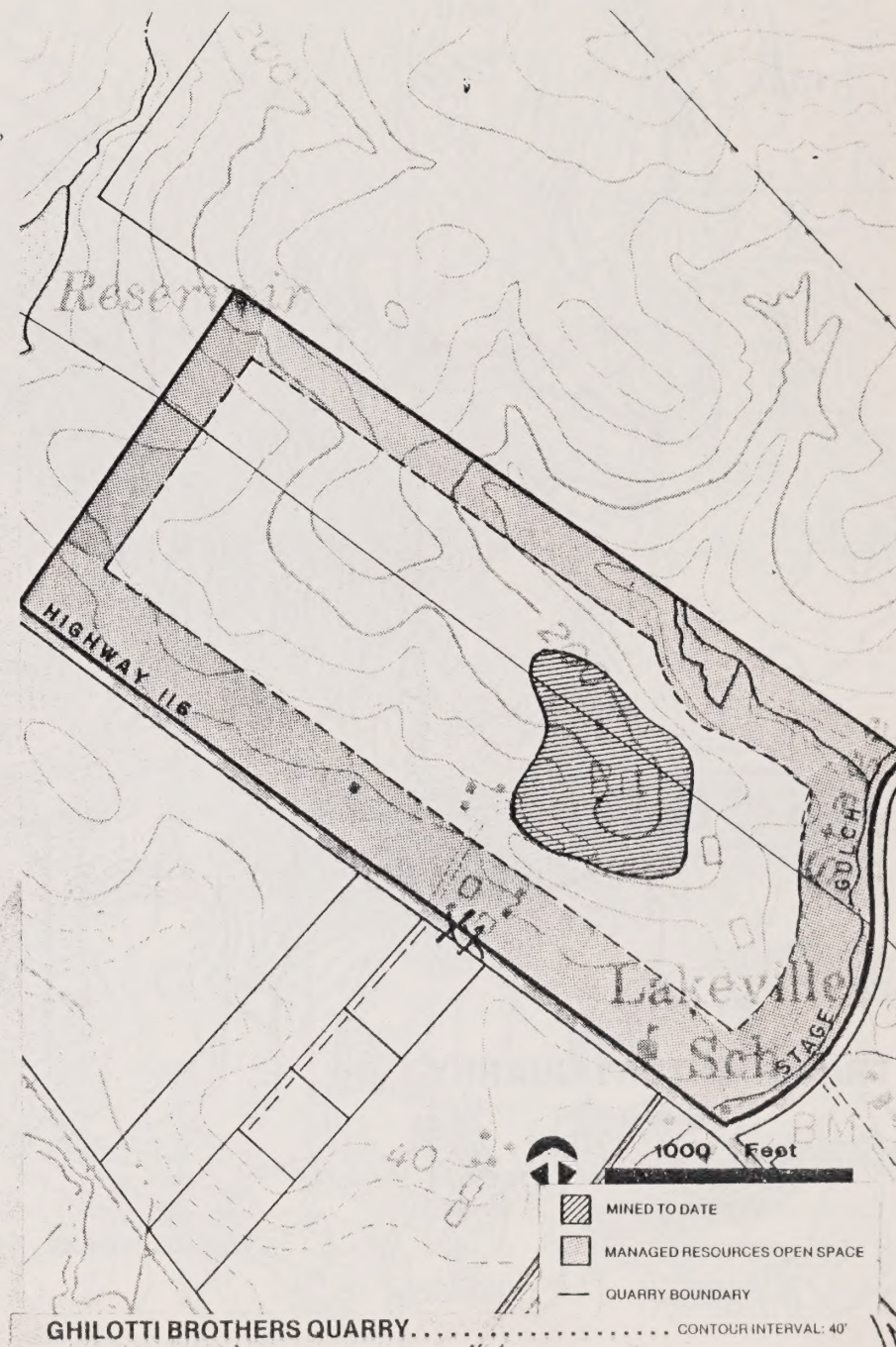
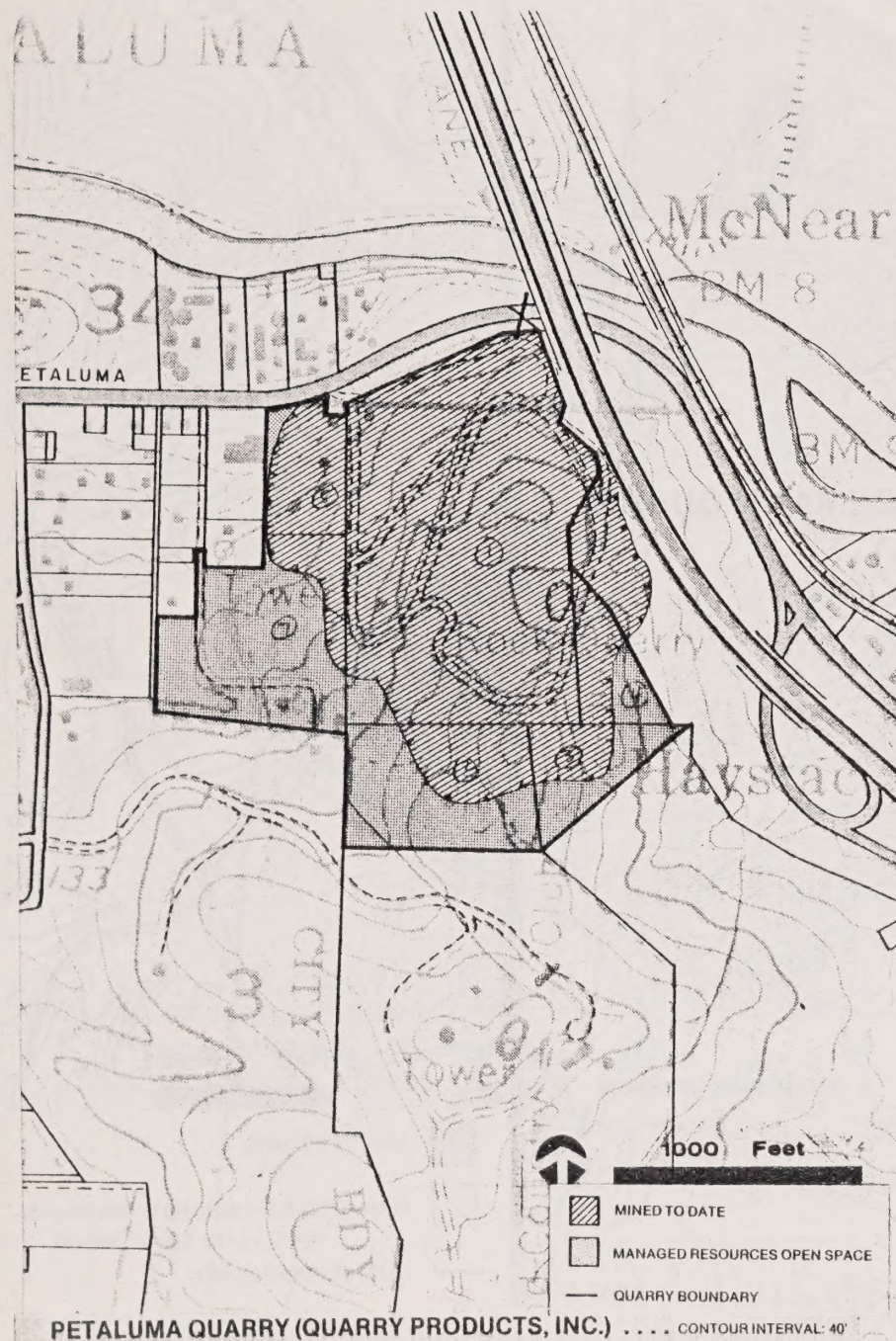


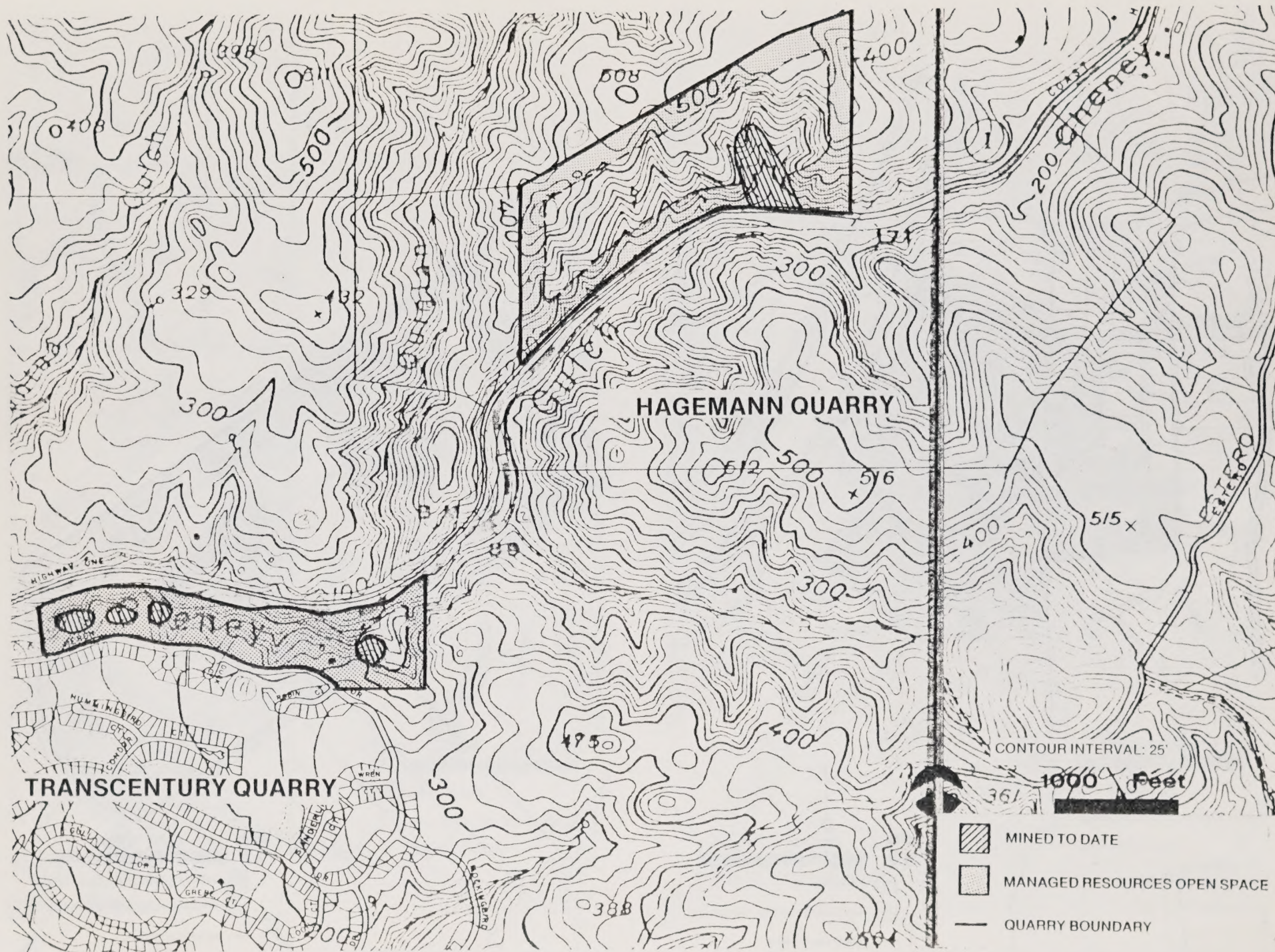
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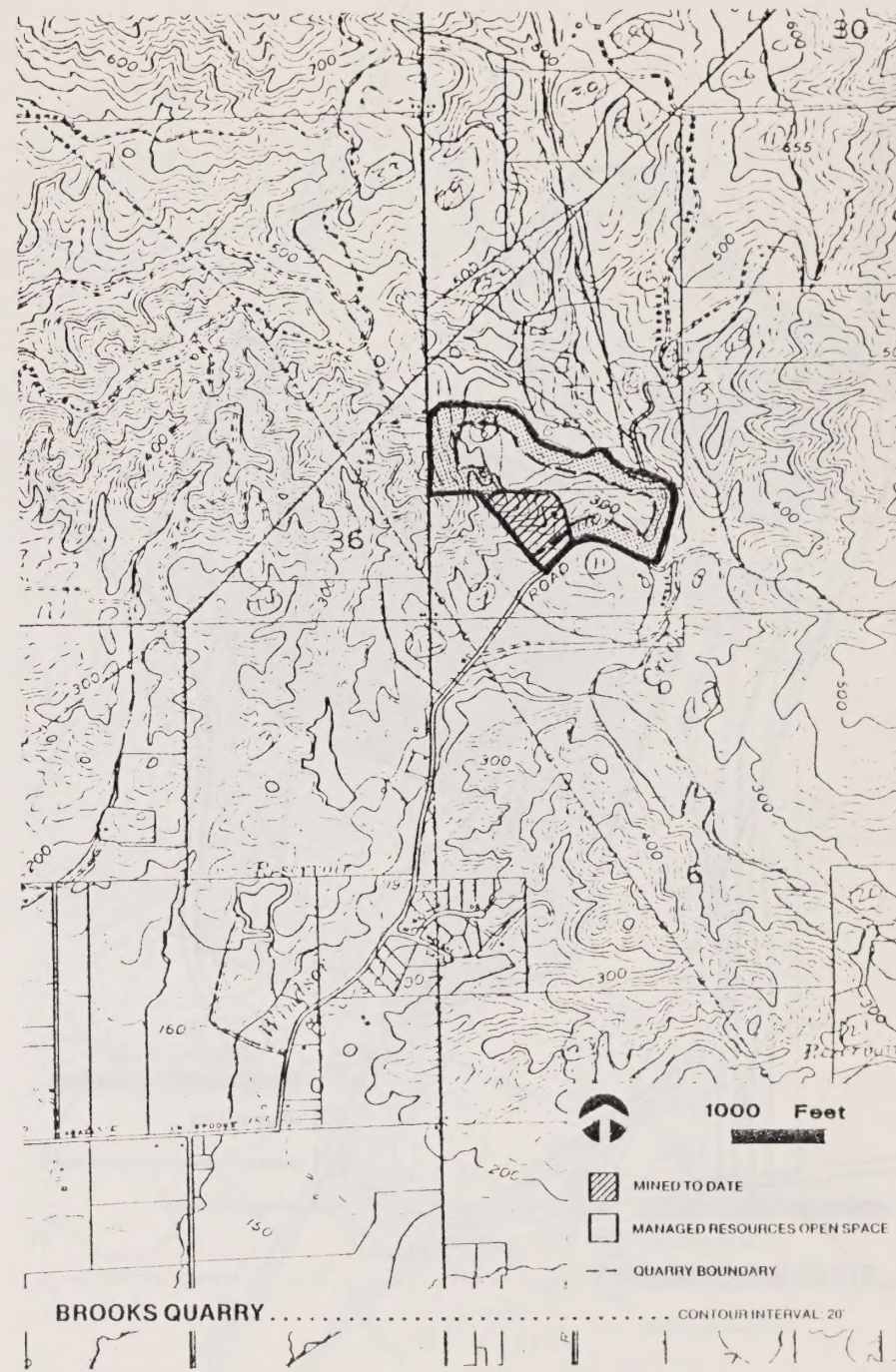
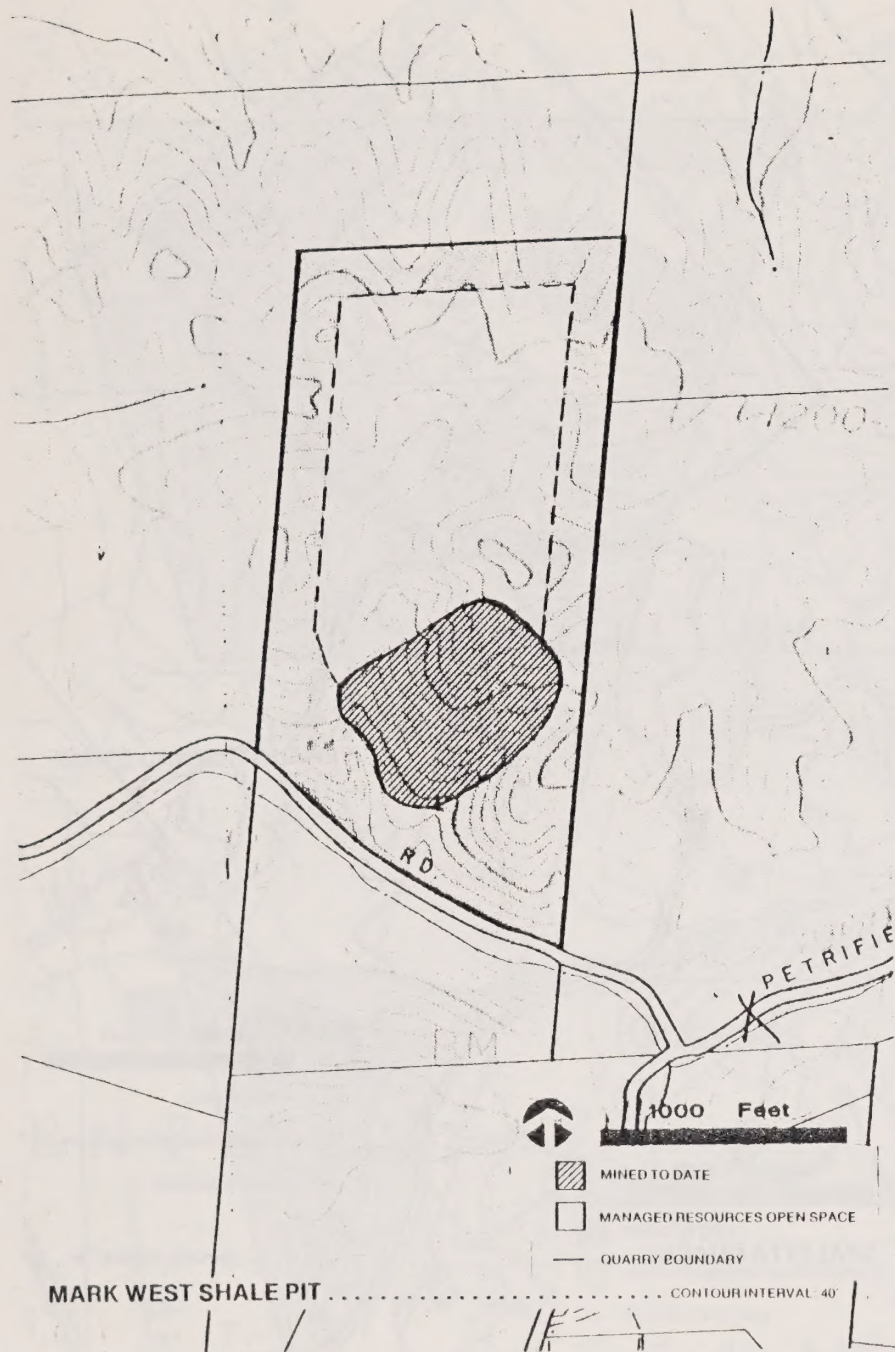


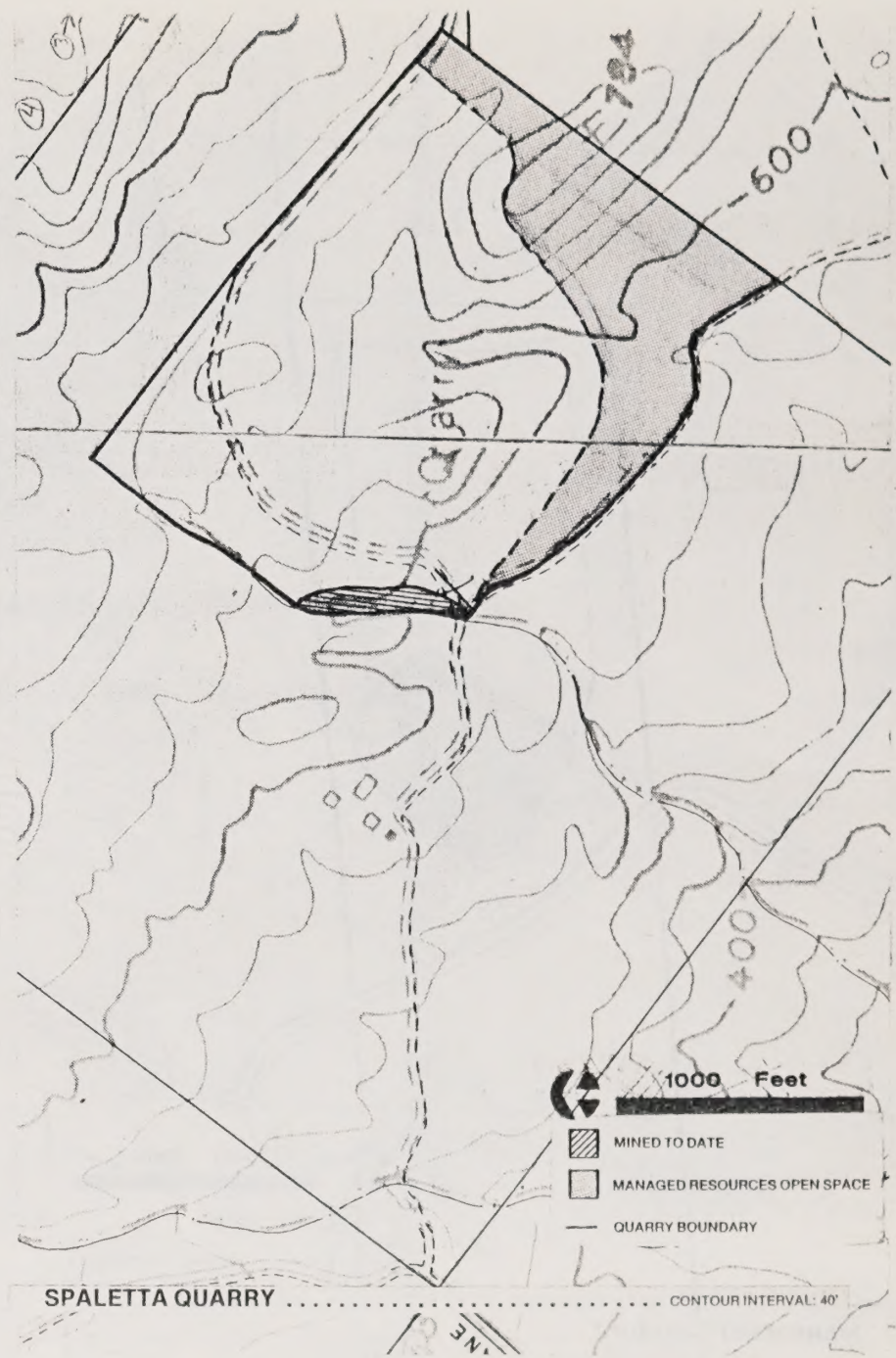
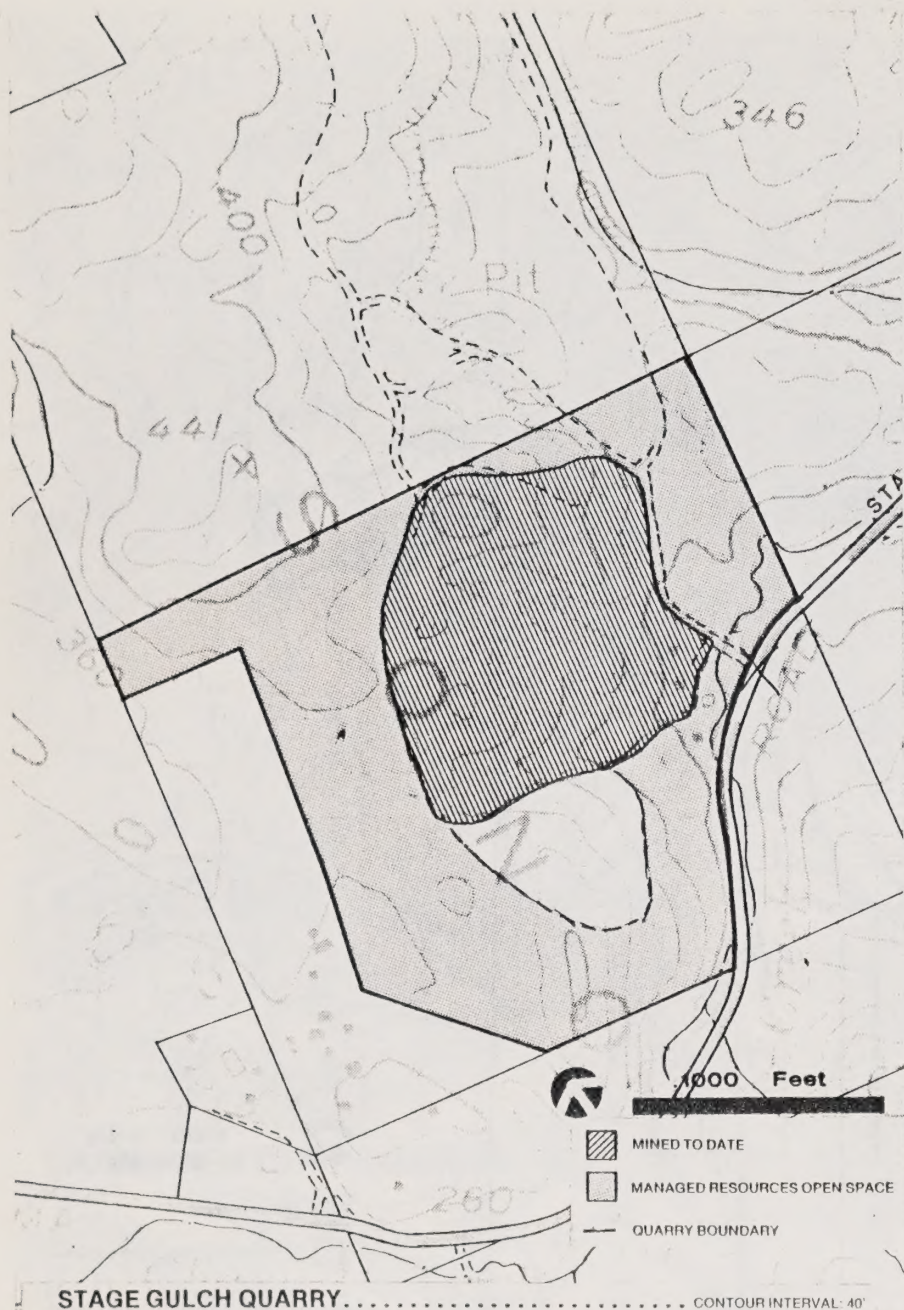


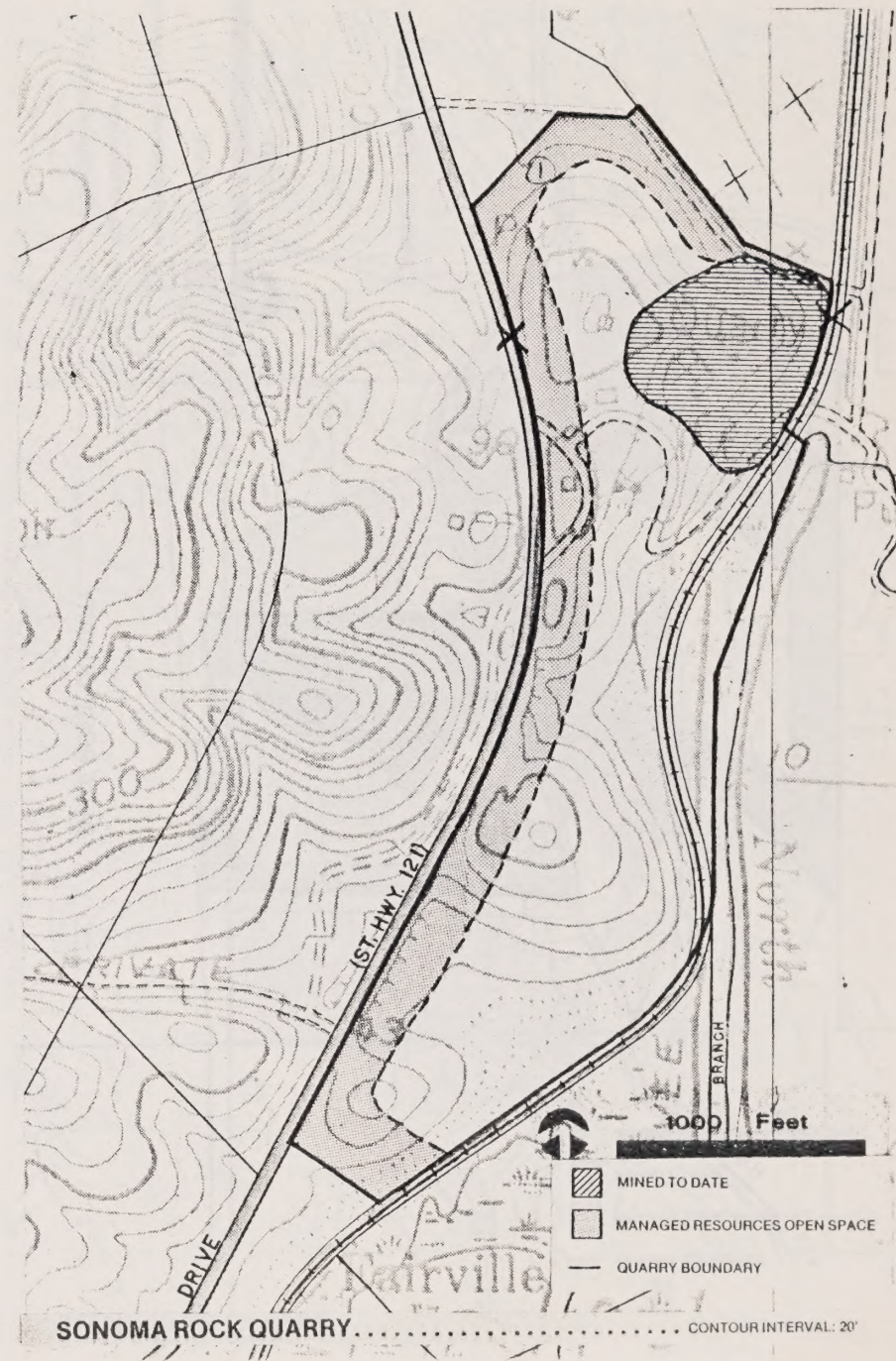
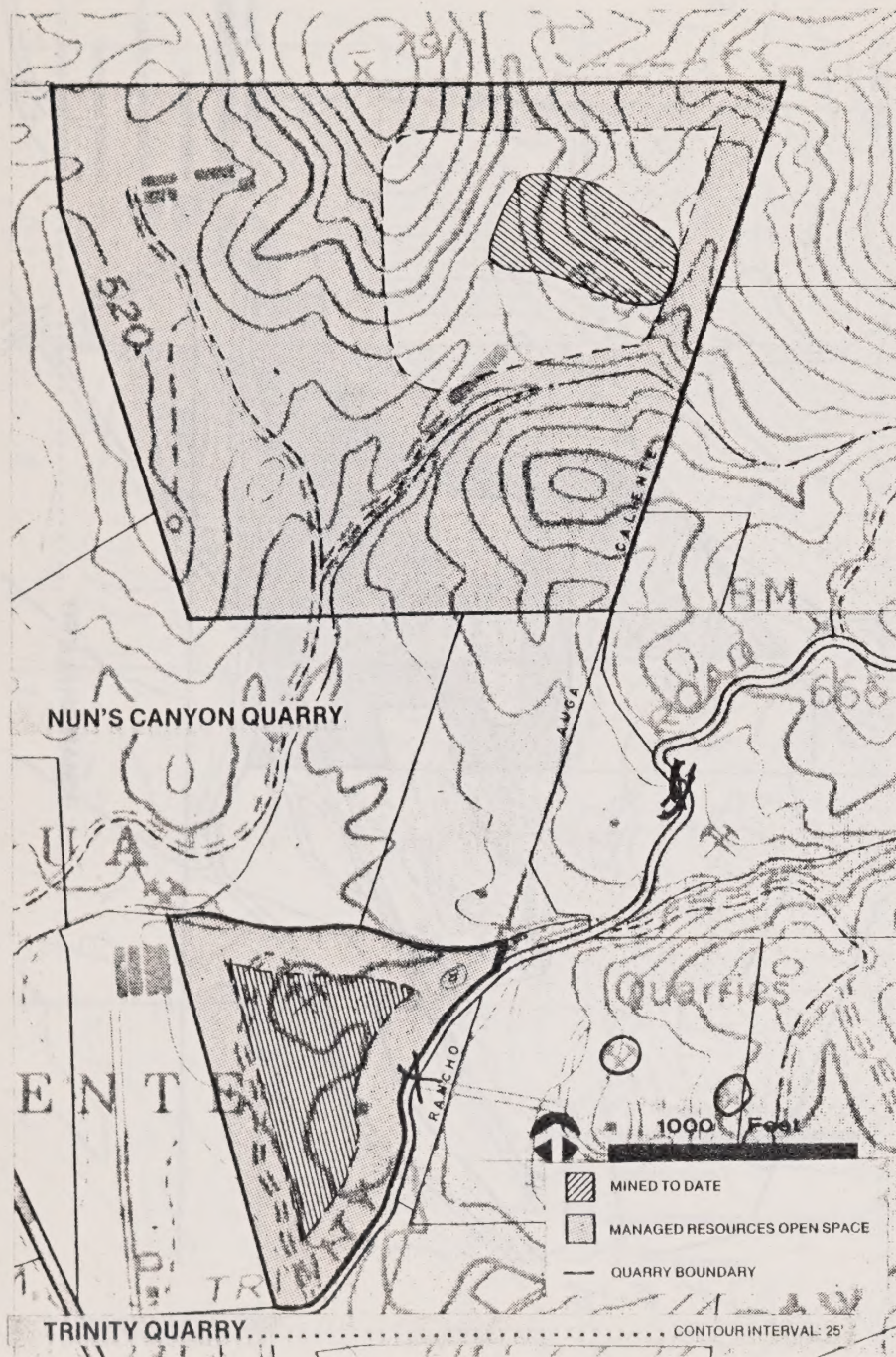


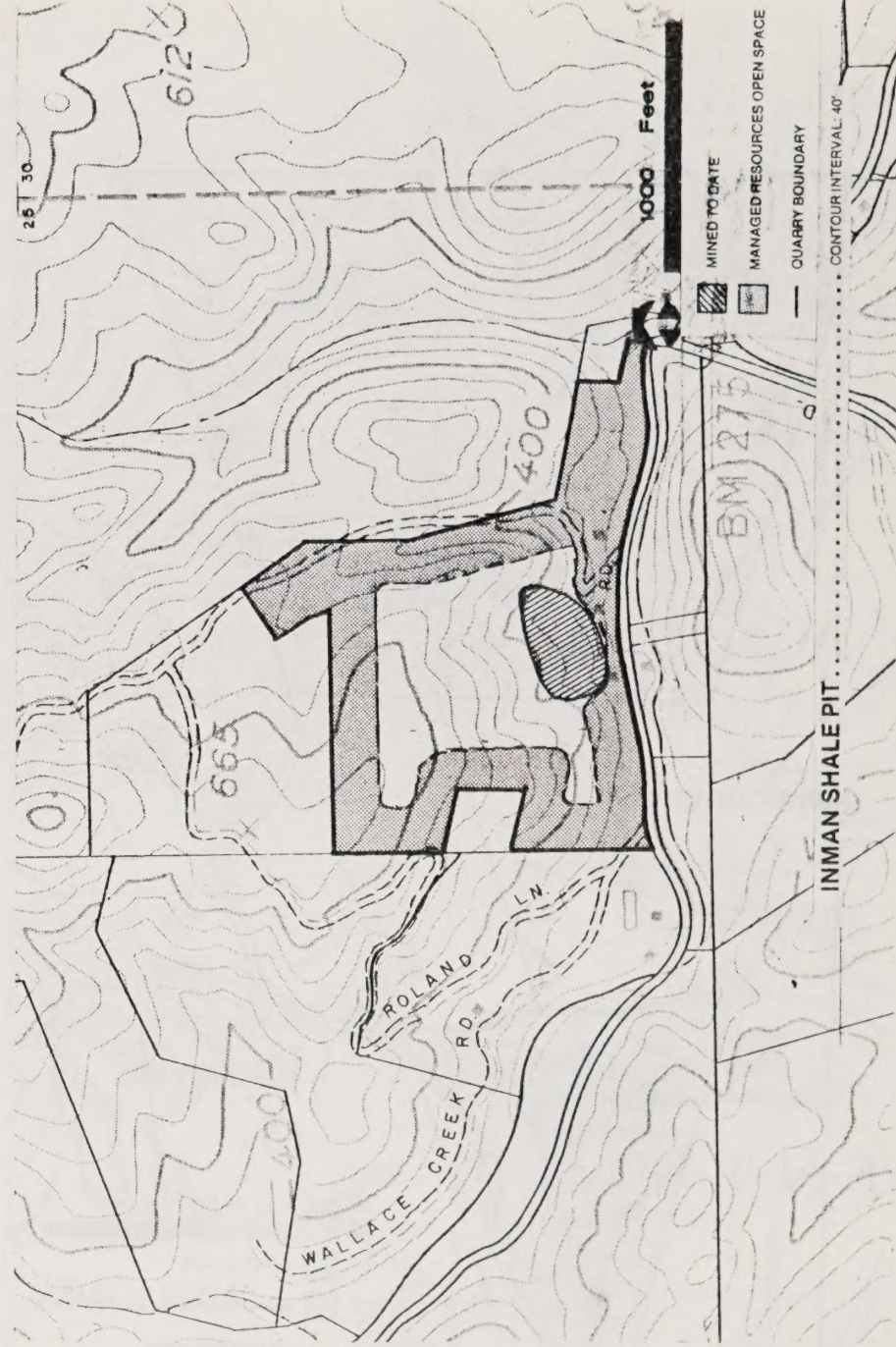
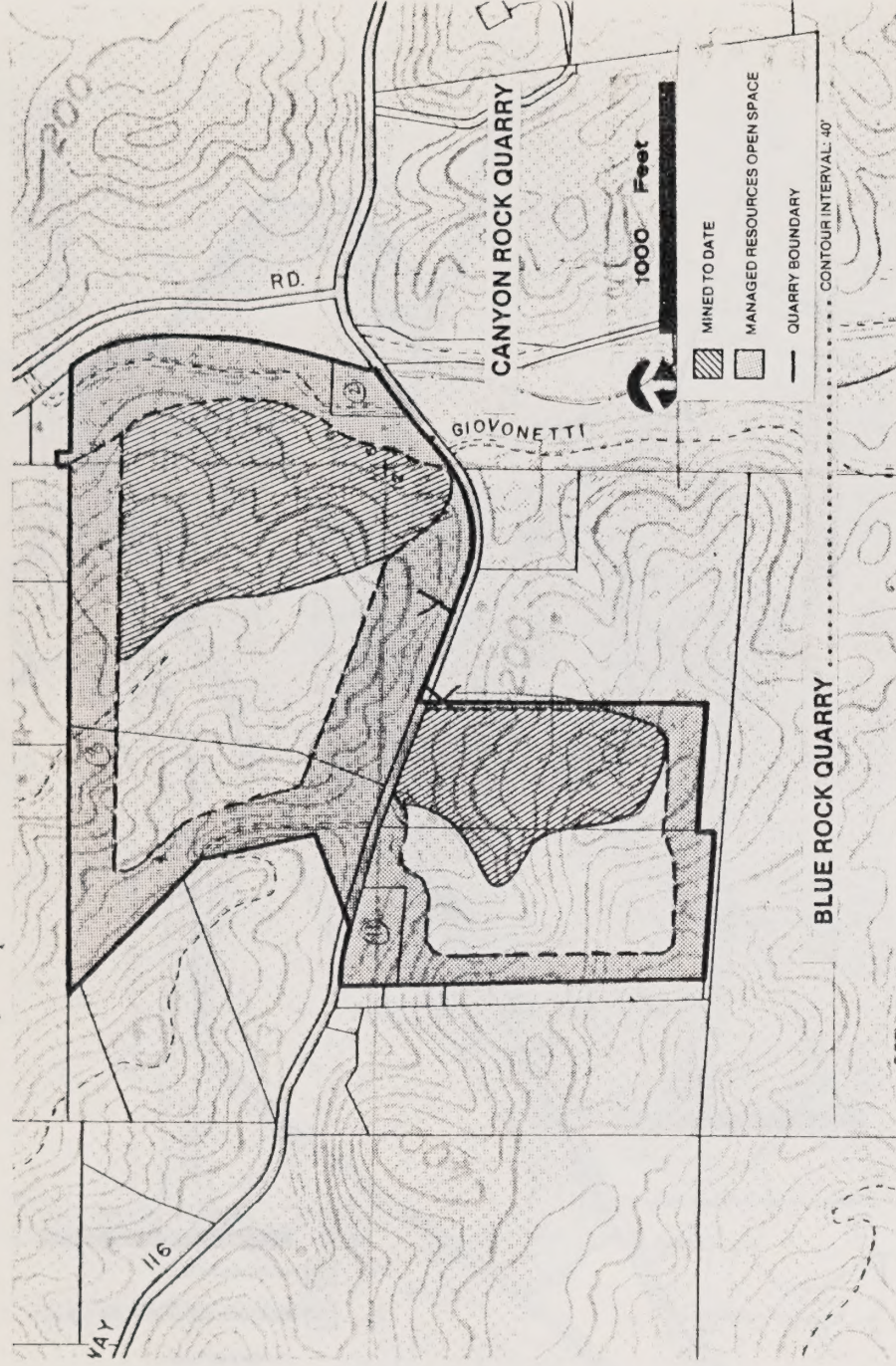


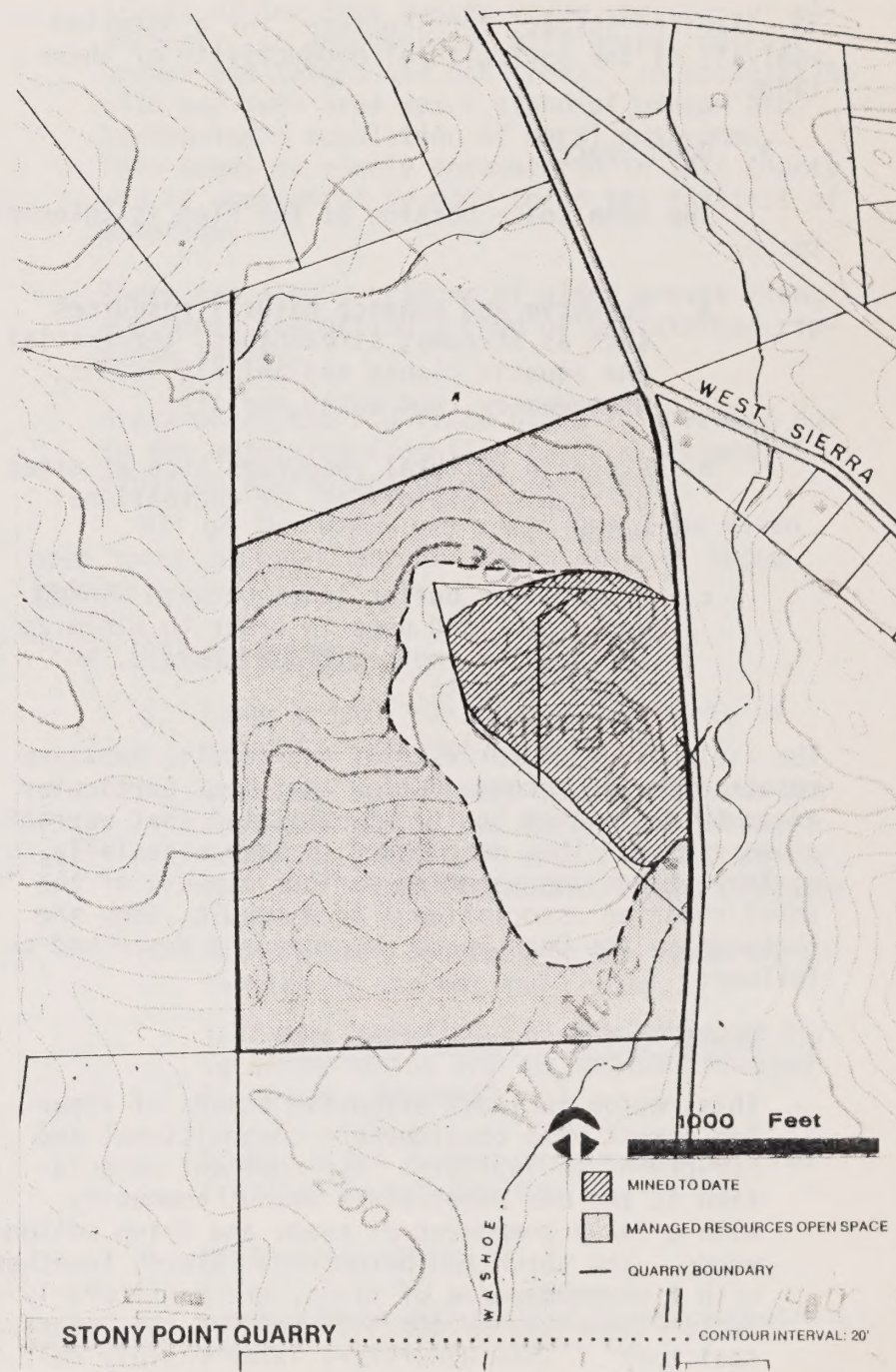
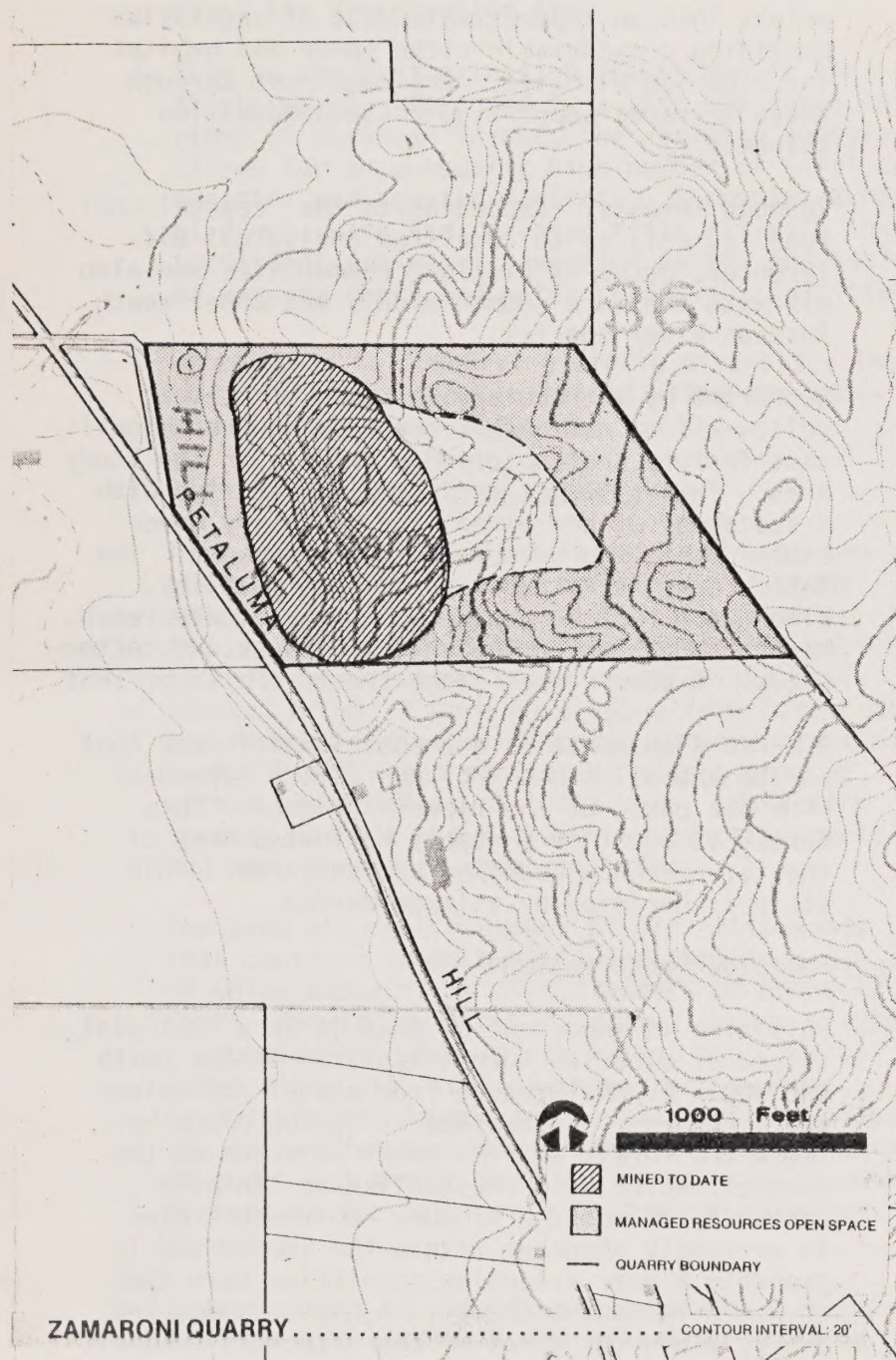












IV Topical Issues: Agriculture, for a detailed analysis of the agricultural productivity of these lands.

3. Open Space

The open space portion of the Plan is intended to:

- a. Preserve and enhance natural resources such as streams, streambanks, terrestrial and aquatic plants and animals, soils, groundwater, and water quality.
- b. Preserve cultural resources such as areas of scenic, historical, or recreational value.
- c. Provide for buffer zones between mining and other land uses in order to minimize air quality, noise, truck traffic, and visual impacts.

The field study of terrestrial and aquatic habitats resulted in the recommendation that four particular areas be designated "critical habitats" that warrant preservation. They were found to have especially healthy stands representing various aspects of the total riparian association. As a result, they are included in the Open Space category and described as follows:

a. Wohler Bridge Preservation Area

This region includes extensive stands of riparian forest with considerable compositional and structural variability. The dominant association is the box elder/black walnut community with a large component of snags and dying cottonwoods. The shrub and herbaceous layers, together with a preponderance of vines, are particularly dense--augmented by the influence of the "coastal cool zone". This understory layer rapidly de-

velops into an impenetrable mass of vegetation providing considerable niche space and habitat for riparian wildlife. Drainages cut through these terraces supporting cottonwood/willow thickets.

Redwood forests, responding to the "coastal cool zone" as well as to localized geological differences, occur as distinct communities and also mix with the more common middle and upper reach Russian River species.

Supported by a tributary, a stand of climax yellow-willow dominated forest is another significant feature, not observed elsewhere in the Study area. This association is well stratified with a subcanopy of box elders and a shrubby understory consisting of spicebush and dogwood. The latter species is confined to this locality. Wild grape, on the demise along the middle reach, occurs as a vine on the yellow willows and cottonwoods. A pomo basket-sedge tract is also present.

The area also contains a transitional forest that may be a small remnant of the valley oak-coast live oak phase of the riparian forest. This forest at one time probably dominated many of the terraces now occupied by vineyards. This strip is bordered by a large meadow.

b. Eastside Preservation Area

This area is important in that it is a vestigial island of riparian forest isolated to the north and south by disturbance from gravel operations and vineyards. Succession is taking place between the forest and the banks adjacent to the channel, which will reestablish an "interim" community in about a decade. Dutchman's pipe is extremely abundant within the forest and is probably a more extensive population here than anywhere in Sonoma County. A basket sedge bed occurs along the banks of the tributary channel.

c. Point Bar Preservation Area

This is the most extensive gravel bar in the Middle Reach. Bordered by a thin but dense corridor of riparian forest, the variable topography allows for an unusually high number of seral communities and aquatic habitats. A complex array of dunes, bars and terraced flats mix with intermittent drainages, overflow basins and swales of varying depth and water retaining capacities.

In addition to conserving biotic diversity, the preservation of this bar would allow for additional studies of succession.

d. Geyserville-Asti Preservation Area

This region includes the largest and most continuous belt of riparian forest in the study zone, with oak woodland occupying both sides of the channel. Associated with the forest habitats is an extensive sequence of gravel bars, several of which were developing into forest at the time of the study. Spring surveys revealed over 150 different species of plants growing within the confines of these bars. Many more species had not begun their reproductive cycle and were therefore unidentifiable.

The area also has a number of old cottonwoods that continue to be healthy and thriving, one of which had a trunk circumference of about 12 feet. Nearly undisturbed, climax stands of the cottonwood/box elder/black walnut association exist along with some of these cottonwoods. *Periwinkle* and *Arundo* are locally absent, allowing for a more varied and stratified understory of trees and shrubs that was at one time a common feature in the California bottomland riparian forests.

Several areas of notable ethno-botanical significance were observed; characterized by large

tracts of the Pomo basket sedge, patches of elderberry, an abundance of wild grape, buckeye groves and large, old oak trees. In association with one such area was a stand of Oregon ash harbouring a population of morel mushrooms. This genus is rarely encountered in this county and is considered by many to be the tastiest of mushrooms.

There are also corridors of alder groves along a hummock supporting a band of undisturbed riparian forest.

Areas where the old flood plain is narrowed due to the adjoining foothills favor a mixture of riparian and upland plant communities.

All of the following areas have been given open space designations for one or more of these reasons:

All Operations

- a. Lands within 200 feet of the banks of major streams and tributaries.
Instream Operations: Lands proposed for instream mining are designated "Managed Resource: Mineral" with a buffer of fifteen (15) feet streamward of the ordinary high water mark.
- b. Lands within 100 feet of the banks of intermittent streams and creeks.
Instream Operations: Lands proposed for instream mining are designated "Managed Resource: Mineral".
- c. Scenic areas mapped on the General Plan Critical Open Space Map.
- d. Historical sites.
- e. Lands within 400 feet of fixed recreational areas.

- f. Lands within 400 feet of areas designated as "Parks", "Natural Areas", or "Development Areas" on the Resources Undeveloped Areas Map.
- g. Lands within 200 feet of "undeveloped" or "managed resource" areas on the Resources and Undeveloped Areas Map.
- h. Lands within 300 feet of a scenic route on the Critical Open Space Map.
- i. Hardrock operations: All prime soils (SCS) and aquifer recharge areas.

4. Reclamation

All lands subject to terrace extraction and/or processing operations since January 1, 1976, and therefore subject to the reclamation standards proposed in Section VII. Also included are those lands proposed for future extraction in the Aggregate Use Plan.

5. Developed or Urban Areas

All lands presently developed for residential use of committed to development in the Sonoma County General Plan.

6. Other Lands

Lands not containing mineral deposits have not been designated in the Managed Resources/Open Space Plan. Most of these lands are suitable for and are presently used for agricultural purposes.

D. HYDROLOGICAL CHANGE PLAN

The Hydrological Change Plan is intended to provide for reasonable stream management of the Russian River and Dry Creek with respect to existing and

future mining operations. It is supportive of both the Aggregate Use Plan and the Managed Resources/Open Space Plan in that it seeks to:

- 1) Regulate instream and near stream extraction so that maximum mitigation of adverse environmental effects occurs.
- 2) Limit future instream extraction to "safe yield" or annual replenishment levels.
- 3) Preserve soil resources and agricultural lands adjacent to the instream channels.
- 4) Maintain and enhance streambank stability while encouraging deposition, rather than erosion of fluvial materials.
- 5) Preserve and enhance the growth of riparian vegetation.
- 6) Preserve areas of aquifer recharge.
- 7) Maintain groundwater supplies and quality.
- 8) Maintain surface water quality.
- 9) Provide limited flood control.
- 10) Promote river-oriented recreation.

The Plan consists of three parts: a hydrological monitoring program, an interim hydrologic change plan, and a set of standards regulating instream and terrace extraction based on the interim plan.

1. Monitoring Program:

In the absence of adequate or conclusive data on the hydrologic characteristics of the Russian River or Dry Creek channel and changes resulting from mining and other activities, a systematic monitoring program of river hydrology is proposed. It is described in Section VII (Management Process).

2. Interim Hydrological Change Plan:

Some time will be required before the suggested monitoring program yields more conclusive information about the impacts of mining activities on river hydrology. As a result, an interim plan is proposed, subject to later revision when more data are available, based on existing data and present understanding of the hydrologic behavior of stream channels in response to physical changes.

3. Regulation of Mining Operations:

Standards for instream and terrace operations and reclamation are proposed in order to implement the interim plan. They are described in Section VII (Management Process) and are also subject to later revision based on new data.

The Interim Hydrological Change Plan contains the following provisions related to mining operation and reclamation in the Middle Reach, Dry Creek Valley, and Alexander Valley. The plan is supportive of and is part of the basis for the recommendation of the Aggregate Use Plan.

Middle Reach and Dry Creek

1. Permit no further instream mining activities in Dry Creek or in the Russian River downstream of Healdsburg Dam unless streambed materials build up to the extent that substantial lateral erosion will result from flow diversions against the stream banks. Due to the Healdsburg and Warm Springs Dams, it is unlikely that sufficient replenishment will occur in this area for many years. At such a time that instream mining becomes necessary, it shall be conducted according to standards outlined in Section VII.
2. Permit mining activities upstream of Healdsburg Dam according to instream mining and reclamation

standards outlined in Section VII.

3. Mining and reclamation activities in the valley will be conducted so that channel constriction or narrowing is discouraged and sediment and bedload deposition is encouraged.
4. Where necessary, streambank levees, riparian vegetation and other bank protection measures will be used and maintained to protect agricultural lands from erosion, yet allow soil replenishment during flood flows. (see Reclamation Map in Section VII).
5. Terrace pits adjacent to the streambed will be protected from bedload flow although suspended sediments may be carried into the pits by flood waters which over-top the channel banks.
6. Permit no terrace extraction operations after the three-year transition period. Future operations will be located adjacent to existing sites so as to minimize impacts on riparian vegetation, groundwater, and river hydrology as well as to accomplish other provisions of this plan.
7. Reclamation plans submitted in this area shall be coordinated among all operations so that plan approval considers the cumulative hydrological impacts of reclamation activities for the entire stream channel.
8. Permit no extraction, either in channel or terrace within Wohler, Eastside, or Point Bar preservation areas. (see Vegetation Map, Section II).

Alexander Valley

1. Permit extraction operations within any or all of the "Managed Resource: Mineral" areas according to the standards outlined in Section VII (Management Process).

2. Limit the annual extraction from each zone to the amount replenished during the previous winter. This amount will be determined by monitoring data each spring.
3. Permit no terrace extraction.
4. "Oversize" gravels (+3") and boulders extracted during instream operations will be used to stabilize streambanks in extracted areas.
5. Mining and reclamation activities will be conducted so that channel constriction or narrowing is discouraged and sediment and bedload deposition is encouraged.
6. Access to instream materials will be achieved by a combination of haul roads through the riparian zone and crossings through the live summer channel.
7. Reclamation for instream mining operations will consist of annual post extraction measures as well as post operation measures.
8. Permit no processing operations other than the screening and removal of "oversize" (+3") gravels within stream channels or within the riparian corridor.
9. Permit no extraction in Geyserville-Asti preservation area. (see Vegetation Map, Section II).

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SECTION 6

1. "Sonoma County Commercial and Industrial Study" Draft Report, Sonoma County Planning Division, December, 1979.
2. "Franz Valley Specific Plan", Sonoma County Community and Environmental Services, 1979.
3. "State Policy for Surface Mining and Reclamation Practice", Special Publication No. 51, California Division of Mines and Geology, 1977.
4. Sonoma County General Plan, Sonoma County Community and Environmental Services, adopted 1978.
5. Reconnaissance of Potential Hardrock Quarry Site, Sonoma County, California; Dr. Ralfe Erickson, et al., 1979.
6. "West Sebastopol Specific Plan", Sonoma County Community and Environmental Services, October, 1979.
7. "Guidelines for Classification and Designation of Mineral Lands", State Mining and Geology Board, 1978.
8. "General Plan, City of Sonoma", 1974.
9. "General Plan, City of Cloverdale", 1969.
10. "City of Rohnert Park, General Plan", 1973.
11. "Healdsburg Area General Plan Elements", 1971.
12. "Santa Rosa General Plan", 1977.

13. Harrison Grade Study, Sonoma County Planning Department, 1975.
14. "City of Petaluma, Environmental Design Plans", 1978.
15. "A General Plan for the City of Cotati", 1972.
16. South Sonoma Valley Areas I and II Specific Plan, Sonoma County Planning Division.
17. South Sonoma Valley Areas III and IV Specific Plan, Sonoma County Planning Division.
18. North Sonoma Valley Specific Plan, Sonoma County Planning Division.
19. Forestville Specific Plan, Sonoma County Planning Division.
20. Bennett Valley Specific Plan, Sonoma County Planning Division.
21. Sonoma Mountain Specific Plan, Sonoma County Planning Division.

VII. MANAGEMENT PROCESS

The management process associated with the proposed Aggregate Resources Management Plan is intended to provide a means of plan implementation as well as periodic review of mining activities, regulatory efforts, reclamation plans, adjustments in the Management Plan itself and its implementing ordinances and standards. The process includes the following:

Part A: The establishment of a Mineral Resource Zoning District and a permit application procedure which would assure that future extraction take place within that district.

Part B: A series of mining operation standards to be included as amendments and/or additions to the Sonoma County Surface Mining Ordinance, Chapter 26A, 1-17.

Part C: A series of mining reclamation standards to be included as amendments and/or additions to the Surface Mining Ordinance, Chapter 26A, 1-17.

Part D: A monitoring system of present and future mining and reclamation activities.

PART A: MINERAL RESOURCE DISTRICT

Under the provisions of the present County Ordinance regulating surface mining and reclamation, as of July, 1978,

"No person shall conduct surface mining operations unless a surface mining permit is obtained and a reclamation plan is approved. . . ."

Under the provisions of the present Zoning Or-

dinance, commercial extraction of aggregate materials is permitted by use permit in all agricultural zones, while the processing and manufacture of aggregate products is permitted in either the "Heavy Industrial" (M2) or "Secondary Agriculture" (A2) zones.

Recognizing the importance of mineral resources to the County and in order that incompatible uses not preclude the extraction of deposits necessary to meet future aggregate demand, a Mineral Resource (MR) zoning district is proposed. The MR district will be applied only within lands designated as "Managed Resource: Mineral" by the Managed Resources/Open Space Plan described in Section VI.C.

The adoption of the proposed management plan includes the rezoning of the following hard-rock operations to the MR district:

Bloomfield Quarry
Blue Rock Quarry
Canyon Rock Quarry
Bohan and Canelis Quarry
Cinnabar Rock, Inc., or Guerneville
Quarry
Ghilotti Brothers Pit
Chenoweth Quarry
Inman Shale Pit
Mark West Shale Pit
Arfsten Pit
Trinity Quarry
Quarry Products, Inc., Petaluma
Quarry
Sonoma Rock, Inc.
Zamaroni Pit

The remainder of the existing hardrock operations are located on lands under Type II Williamson Act contracts. For these operations, no rezoning will be required within the parcels currently being mined. However, before extraction can begin on an adjacent parcel, the ten-year

phase out of the preserve contract must be initiated and approved for lands to be included in the mining operation.

Some of the potential hardrock quarry sources are also located on lands under Type II Williamson Act contracts. When applications are made for mining in these areas, the phase out of the contract for those lands to be mined will be a required condition of mining permit and reclamation plan approval. Upon completion of the phase out, an application shall be made for rezoning to MR. This provision would apply only to those lands under Type II contracts where no Class I-IV soils are present.

Transition period terrace operations, all future instream operations, and hardrock sites not under Type II Williamson Act contract will require that an application for rezoning be submitted along with the use permit application. The two applications would then be processed simultaneously. Provisions of the MR zoning district (see Appendix G) would require a noticed hearing and determination by the Planning Commission for the above applications. Standards for operation and reclamation phases will continue to be determined by the Surface Mining Ordinance. As a result, the following sections of the Ordinance must be amended so that the words "Planning Commission" replace "Board of Zoning Adjustments". Appendix K contains the proposed Ordinance as amended by this Study.

Section 26 A-4: c), d), f), g)

Section 26 A-7: b) iv

Section 26 A-9: a)

Section 26 A-12: a)

Section 26 A-14: a)

The Mineral Resource District also includes the following provisions:

Hardrock Operations

All phases of mining operations, including extraction, processing, batching, and hauling will be per-

mitted according to the standards of the Surface Mining Ordinance.

Terrace Operations

All phases of mining operations, with the exception of product batching, will be permitted according to the standards of the Mining Ordinance. Batching operations will be allowed in industrial zones only.

Instream Operations

Only the extraction operations, removal of oversize gravels, and hauling operations will be permitted within the district. Other processing and batching operations will be allowed in industrial zones only.

Part B: MINING OPERATION STANDARDS

Standards for hardrock, terrace, and instream mining operations are included in the present County Surface Mining Ordinance (Chapter 26 A1-A-17). In order to properly mitigate the adverse environmental effects of mining activities, the following additions and/or amendments to the present operation standards are proposed. (Review Section III, "Detailed Analysis of Impacts of Mining Alternative Source"). The precise wording of suggested changes in the Ordinance is found in Appendix K.

Hardrock Operations

1. Earth Impacts:

- 2A.* Standards for benches on working slopes in conformance with requirements of the California Division of Occupational Safety and Health.

* Initial Study reference (Section IV)

- 2B. Present standard is adequate.
- 2E. The provisions of Sonoma County Ordinance No. 1108 are added to present standards for drainage alterations. It is recommended that Water Agency approval of drainage alterations submitted as a part of an aggregate mining and/or reclamation plan be handled by referral to the agency rather than by the issuance of a separate permit under 1108. In addition, standards for sediment basins, slope protection, and erosion control are incorporated by reference to Sections 20, 30, 40, and 90 of "Erosion and Sediment Control Handbook" prepared by the Division of Mines and Geology of the State Department of Conservation.
2. Air Impacts:
- 3A1. Present standard is adequate.
- 3A2 & A3. A standard specifying the maximum allowable concentration of offsite fugitive dust from processing or hauling operations is included. Furthermore, a setback from the periphery of the site is required for processing operations in order that fugitive dust not severely affect adjacent properties. The setback is either 200 feet or 400 feet, depending on the nature of adjacent uses.
3. Water Impacts:
- 4C & D. Changes proposed under 2E above are adequate.
4. Biological Impacts:
- 5ABC, Standards requiring a setback of 100 feet
- 6DE: from streams, streambanks, sensitive areas, riparian corridors, areas of critical habitat, or unique biotic areas are included. Extraction operations may be permitted to within 25 feet of some of the above areas in accordance with an approved reclamation plan.
5. Cultural Impacts:
- 7AB: Setbacks are established from the periphery of the mining site for purposes of noise attenuation. Setbacks are 200 feet or 400 feet, depending on the nature of adjacent uses. The present standard which allows noise levels to be measured at the nearest residential structure is amended to read, "at the nearest boundary of the MR district".
- 13F: The standard requiring traffic warning signs has been expanded to include other traffic management facilities as well, such as bicycle lanes, acceleration/deceleration lanes or turning lanes.
- 13H: A standard is included requiring that mining operations assist in public road maintenance when roads proposed for use in hauling aggregates must be upgraded to accommodate the additional truck load.
- 14B: Standards for fencing, lighting, and site patrol for the prevention of vandalism are included along with the present standards.
- 17A: Present standard is adequate.
- 18B: The present standard for sight regulation has been amended to include the construction of berms and visual screening from residential and recreation uses, scenic routes, and scenic corridors. A 300-foot setback is included for hardrock operations adjacent to a designated scenic route or highway.

20. A standard is included requiring an archaeological site reconnaissance prior to the commencement of any earth moving activities.

Hardrock Operations: Other Impacts

- C1: A standard is added requiring that no extraction, processing, and stockpiling operations be conducted in any aquifer recharge area. Present standards as amended are adequate to mitigate other impacts on aquifer recharge.
- C3: Present standards are adequate.
- E1: Present standards are adequate as previously amended.
- E3: The standards for the use of explosives have been changed so that advanced notice of blasting is required and that proper measures are taken to minimize noise generated by the blasting operation.

Terrace Operations

1. Earth Impacts:

- 2B: Present standard is adequate.
- 2D: A standard is included prohibiting any extraction, processing, or batching operation from occurring on soils suitable for intensive crop production according to SCS. Transition period terrace operations are exempt from this prohibition.
- 2E: The standards for erosion, sedimentation and pollutant discharge are adequate as amended to include erosion from topsoil stockpiles and surface pit slopes.

The standards for protection of streams, streambanks, and riparian corridors are similar to those for hardrock operations. However, a 200-foot setback from the Russian River or 100 feet from any other riparian or sensitive areas is required for all phases of mining activities unless in accordance with an approved reclamation plan.

- 2G: The present standards, as amended under 2E above, are adequate.

2. Air Impacts:

- 3A1, A2, A3: Present standards, as amended under Hardrock Operations, are adequate.

3. Water Impacts:

- 4A: Present standards, as amended, are adequate.
- 4B: Present standards, as amended, are adequate.
- 4C: Present standards, as amended, are adequate.

- 4E: Standards for drainage alterations are adequate as previously amended. Additional standards are added requiring that where terrace extraction occurs within 200 feet of the river channel, measures be taken to prevent bank failure and the direct exchange of flood flows between the channel and the pit. These measures shall be subject to Water Agency approval as above and conform to standards published in the Agency's "Flood Control and Design Criteria" and the "Erosion and Sediment Control Handbook", Sections 60 and 70, on channel protection and grade control referenced earlier.

- 4G: Present standards, as amended, are adequate.

- 4J: Present standards, as amended, are adequate.

4. Biological Impacts:

5A, E, G and Present standards, as amended, are
6A, D, E: adequate.

5. Cultural Impacts:

7AB, 13F, 13H, 14B, 17A, and 18B:

Present standards, as amended, are adequate.

19: A standard requiring a 400-foot setback between terrace operations and fixed location recreational uses is included under setbacks. Extraction and hauling operations may be permitted within 200 feet of these recreational areas if special mitigation in accordance with an approved reclamation plan is provided.

Other standards are adequate as amended.

20A: Present standards, as amended, are adequate.

Instream Operations

1. Earth Impacts:

2A: A standard is included under instream operations prohibiting extraction which results in excessively steep streambanks. In addition, the placement of oversize gravels screened from the extracted raw materials is required along the streambank at the ordinary high water mark. (U. S. Army Corps of Engineers)

2B: A standard is added limiting the removal of riparian vegetation above the ordinary high water mark to that amount necessary for access purposes only.

Another standard is added prohibiting any aggregate processing operation other than that required to screen oversize gravels from being conducted in a stream channel, riparian corridor, or within 200 feet of any streambank as defined by the ordinary high water mark.

2C: Standards added under 2A above are further defined to establish three dimensional boundaries for extraction by the skimming method; transverse gradient, longitudinal gradient and planimetric or map boundaries. (See accompanying diagram.)

2D, 2E, Present standards, as amended and added
2F, 2G: to above, are adequate.

2. Air Impacts:

3A1, A2, Present standards, as amended under
A3: Hardrock Operations, are adequate.

3. Water Impacts:

4A: Present standards, as amended above, are adequate.

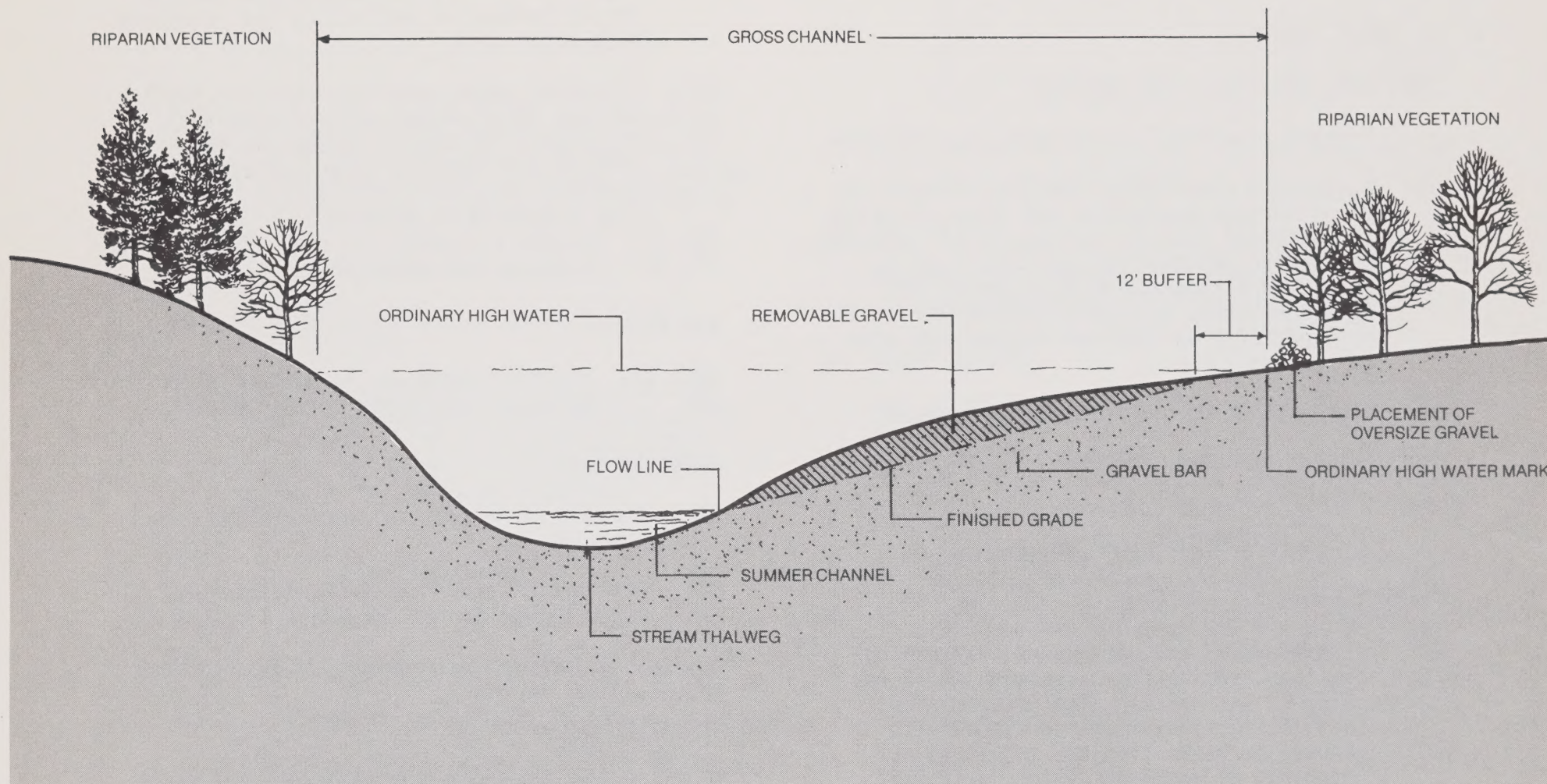
4B: A standard specifically prohibiting in-water extraction is included.

4C, 4E, 4G, Present standards, as amended, are
4H, 4I, 4J: adequate.

4. Biological Impacts:

5A, 5C, Some standards are adequate as amended.
6A, 6D, Others are added to the section on in-stream operations as follows:
6E:

(1) A requirement that access routes be constructed perpendicular to the stream channel when traversing through areas of riparian vegeta-



INSTREAM EXTRACTION LIMITS

tion is included.

- (2) Another standard limits the width of access routes to that necessary for the passage of one vehicle (15 feet).
- (3) A standard is added prohibiting the use of any equipment in water, except for that necessary for the placement or removal of an instream crossing in accordance with methods approved by the Regional Water Quality Control Board and the Department of Fish and Game.
- (4) A standard is added prohibiting extraction activities within 1,800 feet of tributary streams unless site specific conditions exist such that impacts on the tributary mouth habitat can be mitigated to the satisfaction of the Department of Fish and Game.
- (5) Standards are added for instream crossing placement, and removal consistent with those of the North Coast Regional Water Quality Control Board and the State Department of Fish and Game. Notice of such activities for monitoring purposes is also required.
- (6) Standards for the timing of instream extraction activities as well as the placement and removal of crossings are included, based on fish migration and spawning periods.

5G: Present standards, as amended, are adequate.

5. Cultural Impacts:

7AB: Present standards, as amended, are adequate.

9B: Standards amended under 2A and 2C are further defined to include absolute limits on the quantity of raw materials extracted from each instream mining site based on annual recharge as determined by pre- and post-extraction topographic cross sections produced by the hydrology monitoring program.

13F: Present standards, as amended under Hard-rock Operations, are adequate.

13G: The standards previously added covering access through riparian areas are adequate.

A set of standards for stream crossings between gravel bars is included, based on those of the North Coast Regional Water Quality Control Board.

13H: Present standards, as amended under Hard-rock Operations, are adequate.

18B: Present standards, as amended, are adequate.

19: Present standards, as amended, are adequate.

Part C: RECLAMATION STANDARDS

Long-term mitigation for many of the environmental impacts resulting from mining operations can be achieved through proper site reclamation. The State Surface Mining and Reclamation Act of 1975 and the Sonoma County Surface Mining and Reclamation Ordinance require that reclamation plans be submitted for all lands mined since January 1, 1976. Reclamation

can occur at various stages of mining operations and is defined by the State Mining and Geology Board in its guidelines for surface mining and reclamation practices as follows:

Reclamation. The combined process of land treatment that minimizes water degradation, air pollution, damage to aquatic or wildlife habitat, flooding, erosion, and other adverse effects from surface mining operations, including adverse surface effects incidental to underground mines, so that mined lands are reclaimed to a usable condition which is readily adaptable for alternate land uses and create no danger to public health and safety. The process may extend to affected lands surrounding mined lands, and may require backfilling, grading, resoiling, revegetation, soil compaction, stabilization or other measures.

The County Ordinance presently contains a set of standards for reclamation activities on the landscape (Section 26A-7(b)). The following standards are proposed as amendments and/or additions to the Ordinance for further mitigation of environmental effects.

Hardrock Operations

Since hardrock operations remain at fixed locations for long periods of time, reclamation activities are often delayed until the operation is nearly complete. If, however, operation phasing is possible at a particular site, reclamation activities can begin at an earlier date for completed phases. This will be encouraged whenever possible in the approval of future plans.

The following are suggested changes in the County Ordinance regulating reclamation activities. A review of Section IV "Detailed Analysis of Impacts

of Mining Alternative Sources" is recommended. Numbers in the left-hand column refer to impacts identified in that section.

1. Earth Impacts:

- 2A. The standard for final slopes is amended to allow for reclaimed benched slopes. In addition, standards for slope revegetation are added requiring that native species particular to an area be used for replanting activities. The reference document for the species list is the report submitted by Madrone Associates during the preparation of the General Plan entitled, "The Biotic Communities of Sonoma County".
- 2B. The standard for resoiling is amended to include specific mention and use of topsoil which has been removed and salvaged.
- 2C. Present standards, as amended, are adequate.

2. Water Impacts:

- 4C & 4D. The present standards for drainage, erosion and sediment control are expanded to include the requirements referenced in "Erosion and Sediment Control Handbook" for sediment basins, slope protection, and erosion control (see Operation Standards, Part B of this Section).

3. Biological Impacts:

- 5ABC, Present standards, as amended in 2A
- 6D. above, are adequate.
- 6E. Reestablishment of impacted riparian habitats should be conducted according

to management recommendations published in "Riparian Woodland: Analysis and Management Recommendations" and the previously mentioned Madrone Associates report on file at the Planning Division.

4. Cultural Impacts:

- 17A. A new standard is added requiring that all equipment used in conjunction with the mining operation that is not necessary for reclamation activities be removed from the site.
- 18B. Present standards, as amended, are adequate.

5. Other Impacts:

- C2, C3, Present standards, as amended, are adequate.
- E1, E2. adequate.

Instream Operations

Instream mining reclamation consists of two parts. The first includes required reclamation practices to be completed at the conclusion of extraction operations each fall. The second part consists of reclamation activities required when an operation is permanently closed down. Numbers in the left-hand column refer to impacts identified in "Detailed Analysis of Impacts of Mining Alternative Sources".

1. Earth Impacts:

- 2A. Present standards, as amended, are adequate.

A standard is added requiring that where access roads traverse the ordinary high water mark of the streambank, oversized gravels will be placed for bank armoring

purposes at the conclusion of each season's extraction. Another standard is added requiring the regrading and revegetation of the same location following any permanent closing down of operations.

Streambank protection measures recommended in "Erosion and Sediment Control Handbook" are incorporated by reference as reclamation standards for areas where instream excavations have contributed to bank instability.

- 2B. Present standards, as amended, are adequate.
- 2D. A standard requiring the placement of oversized gravels at the ordinary high water mark of the streambed for bank armoring is included.
- 2E. Following permanent cessation of an instream operation, ripping and replanting of compacted access routes within 200 feet of the streambank is a requirement added to Section 26A-7 b).

Another standard is added requiring that where processing operations occur within 200 feet of the streambank, sediment detention basins will be constructed so that offsite sedimentation does not occur. Standards in "Erosion and Sediment Control Handbook" shall serve as guidelines for pond construction. Maintenance shall require that accumulated sediments be removed periodically and the basin emptied within two weeks of and no later than November 1 of each year.

- 2G. Present standards, as amended, are adequate.

2. Water Impacts:

- 4A. Present standards, as amended, are adequate.

- 4B. Present standards, as amended, are adequate.

- 4C. Present standards, as amended, are adequate.
4G. adequate.

3. Biological Impacts:

- 5A, 5C, Many of the present standards are
6A, 6D, adequate, as amended, including
6E. those intended for the protection and rehabilitation of streamside riparian vegetation, maintenance of surface water quality, limitations on the depth and extent of extraction, placement and removal of instream crossings, and prevention of excessive siltation of the streambed.

An additional standard is included in the Ordinance limiting operations to particular times of the year so as not to conflict with fish spawning and migration activities.

Another standard is added requiring that bank protection and erosion control devices such as levees, dikes, netting, riprap, etc., be replanted with particular native species.

Another standard is added requiring that following excavation, the gravel bar is graded in such a way that no pools or areas where fish might become entrapped are present. Grading operations may be required to contour the bars in such a way that a series of hummocks are created with an orientation generally parallel to the ordinary high water mark of the channel.

- 5G. Present standards, as amended, are adequate.

4. Cultural Impacts:

- 13G. The timing, method, and other standards for removal of stream crossings shall conform to those of the Regional Water Quality Control Board, which are to be included in the County Ordinance.

- 18B. Present standards, as amended, are adequate.

A standard is included requiring that in areas where processing operations occur within 200 feet of a streambank, provisions shall be made for visual screening with native riparian vegetation according to the standards of 18B above.

19. Present standards, as amended, are adequate.

Terrace Operations

Proposed standards for the reclamation of terrace operations have been formulated so that they provide several options for future land use in the mined area of the Middle Reach. In addition, the location of

the terrace operations in close proximity to each other and the Russian River means that the reclamation plans of individual operations can be coordinated to coincide with a comprehensive land use proposal for the entire mined area. In this light, three future land use proposals are considered and a preferred alternative is selected for reclamation in the Middle Reach.

Agriculture

Recent efforts to reclaim mined terrace lands have attempted to return them to agricultural use. The predominance of farming in the valley and the productivity of the soils warrant that this use be considered for reclamation. The return to agricultural use of mined lands near Dry Creek demonstrates that it is feasible to a limited degree only.

Waste muds from the processing operation are pumped back into the pit. When enough have been deposited, they are covered with a layer of topsoil salvaged at the beginning of the extraction operation. In this case, Basalt Rock Company has planted two vineyards, one of which is beginning its first years of production. Due to the fact that approximately 90% of the extracted materials is sold, however, only 10% of the mined land area can be reclaimed in this manner.

Two other methods of refilling the terrace pits exist, but neither is practical for reclaiming them completely to agricultural use. One method involves refilling the pits with inert materials from another source. Unfortunately, excavation elsewhere would result in environmental and economic impacts in addition to those created by the pit extraction in the first place. Secondly, materials which are available in large enough quantities for disposal in the pits contain salts or other contaminants which would threaten both groundwater quality and agriculture in the valley. In addition, refilling operations for the large number of acres mined to date would continue to affect neighboring property owners and

farmers for the period that would be required to transport fill material into the valley.

The third method of refilling these pits for future agricultural use involves the diversion of stream flows from the Russian River through the pits. Bedload and sediment load normally transported downstream by flood flows would be deposited in the pits, gradually filling them until the original land surface elevations had been restored. Although the flows into the pits could be regulated with the construction of weirs or levees, this method of infill is also impractical and could result in additional hydrologic impacts.

If bedload materials normally transported by the river were allowed to enter the pits, upstream erosion would be greatly increased. Further bed lowering below Healdsburg and Warm Springs Dam would occur with the accompanied loss of riparian vegetation and farmland as gravels moved downstream to reestablish a gentler channel slope.

If the stream flow into the pits were managed so that only suspended sediment entered the pit, infill would take approximately 40 years for a 100-acre, 50-foot deep pit, assuming average peak flow volumes and sediment loads. (Storm, 1979.) Additional problems would also be encountered. One difficulty in such an operation is that when fast-moving stream flow encounters a large body of relatively slow moving water, sediments will be immediately deposited, blocking further flow. Unless the flow gradient is maintained by pumping water out of the pits or periodically dredging the deposited sediments from the entry point, infill will slow or stop altogether. Infill would thus take much longer than 40 years to accomplish. In addition, the reduced sediment load in the stream which will likely result from the closure of Warm Springs Dam will further slow the infill rate. Another impact resulting from the infilling of the pits with sediments is that groundwater transmissivity through the basin would be severely reduced.

Recreation

The second alternative for terrace reclamation in the Middle Reach is recreation. The terrace excavations have created physical topographic features on the landscape which suggest the recreational use. The most important of these features are the lakes immediately adjacent to the river and its associated riparian wildlife habitats. In other parts of the United States and the world, numerous mined out sand and gravel pits have been converted to recreational use, including several pits now part of the East Bay Regional Park District.

The need for water oriented recreation access to the Russian River is clear. While coastal and Lake Sonoma facilities will be available for and attract regional visitors, very little public access is available to the Russian River for local recreationists. According to the Sonoma County Regional Parks Department, a recreation facility in the Middle Reach is badly needed to serve the Healdsburg and Windsor communities. Yet, access to the river area is mostly controlled by the private sector.

A conceptual recreation plan prepared by the Regional Parks Department is found on the next page. The plan suggests various types and intensities of recreational use for particular areas. It consists of both low to moderate and moderate to high use areas connected by a trail corridor linking the various facilities. Nodes of relatively intense use located at each end of the trail are designed to accommodate local recreation demand only.

Recreation activities proposed for heavy use areas include swimming, group and family picnicking, informal field sports, and lake or stream fishing. Activities in the low intensity use areas include sailing, non-power boating, camping, hiking, horseback riding, and bicycling. The use areas are interspersed with "wildlife enhancement" areas which function as buffer zones screening the recreational

activities from surrounding agricultural operations as well as wildlife habitat. The terrace pits themselves are a significant part of the recreational use. With proper sloping and replanting of the pit slopes, they can be used for many of the activities mentioned above.

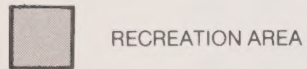
There is a potential for conflicts between recreation and agriculture in the Middle Reach area. However, these could be mitigated by recreational development which included proper site planning of intensive use areas, the encouragement of mostly "passive" or restricted use in some areas, heavy reliance on buffer zones and wildlife enhancement areas, and an effective enforcement program undertaken by the operating organization. Impacts on hydrology and transition period mining operations could be mitigated by development of the recreation plan in accordance with the adopted Aggregate Use, Hydrological Change, and Managed Resources/Open Space Plans.

Conservation and Wildlife Enhancement

The preferred alternative for the future use of terrace-mined lands in the Middle Reach consists of their enhancement as wildlife habitat and scenic and aesthetic resources. The ecotones provided by the water-land interface and the riparian woodlands along the river are ideal wildlife areas. Perhaps the most appealing feature of the Conservation alternative is that the potential for future recreation use is not precluded.

Reclamation standards are included which will encourage the rehabilitation of mined lands for this use. Areas of primary concern are those lands along the river channel and around the perimeter of the pits.

In addition, haul routes, processing sites, and other affected areas will be regraded and replanted with native species according to the specified standards proposed by the biological consulting team. Shore-



Russian River, Middle Reach RECLAMATION RECREATION PLAN

Aggregate Resources Management Study
Community and Environmental Services
Planning Division, Sonoma County Calif.



Scale 0 3000 6000 Feet
0 900 1800 Meters

lines and other potentially erodible lands will be graded and planted so as to minimize erosion, yet not completely prohibit pit infill. Reclamation will also conform to the recommendations of the Hydrological Change Plan and begin immediately upon approval of individual plans in areas where extraction operations have been completed.

Aquaculture

The feasibility of the use of the terrace pits for fish culture is currently being studied by Kaiser Sand and Gravel in coordination with the Department of Fish and Game. Water quality, temperature, pit depth, flooding, and other aspects of two ponds are being studied to determine what species of fish may be grown and harvested there. If feasible, fish culture operations would be compatible with both the recreation and conservation reclamation alternatives. The preliminary results of the one-year investigation indicate that water temperature in the ponds is too warm for the rearing of cold-water fish such as trout or steelhead. Rather, largemouth bass, crappie, or red ear sunfish are better suited for warm waters. Although a commercial operation might be possible, proximity to existing mining operations and steep slopes surrounding the pits would make recreational harvesting infeasible. However, slope reclamation, pond bottom maintenance, and the completion of mining operations would increase the potential for recreational fishing of these species.

Terrace Reclamation Standards

(Numbers in the left-hand column refer to impacts identified in "Detailed Analysis of Impacts of Mining Alternative Sources".)

1. Earth Impacts:

- 2A. A standard is added requiring that unused mud and silt left over after sand

and gravel processing operations be stored on site in a manner which allows their recovery for reuse according to an approved reclamation plan.

- 2B. A standard is added requiring that topsoil salvaged prior to extraction be used for resoiling of areas denuded by mining operations.
- 2D. Present standards, as amended, are adequate.
- 2E. Standards are added for the replanting of pit slopes, denuded streambanks, and bank protection structures.
- 2G. Standards for levee construction and bank stabilization are included by reference to "Flood Control and Design Criteria" of the Sonoma County Water Agency and "Erosion and Sediment Control Handbook". The approximate location of channel levees proposed in the Hydrological Change Plan are shown on the Recreation Alternative Map as the trail corridor. Levee height will be determined by the land surface elevations above the streambank. Levee slopes will not exceed 2 horizontal to 1 vertical. In addition, all levees and other bank stabilization structures will be revegetated according to 2E above.

2. Water Impacts:

- 4A. Present standards, as amended, are adequate.
- 4B. Present standards are adequate as amended in 2E, 5A, 5E, etc.

A standard is included specifying that sediments accumulated in detention ponds be removed within two weeks of and no later than November 1 of each year. This standard will not apply to lands excavated for sand and gravel recovery.

- 4C, A standard is added requiring that
- 4E. levees, bank stabilization structures, and vegetative plantings constructed according to previous standards will be maintained in perpetuity.
- 4G. Present standards, as amended, are adequate.
- 4J. A standard requiring that levees adjacent to terrace pits be constructed with a particular gradation of material that will minimize silt migration into the river.

3. Biological Impacts:

- 5A,5E, Revegetation standards are added specifying both plant species and replanting methodology for denuded riparian areas, pit slopes, etc., as in 2E above.

4. Cultural Impacts:

- 14B. A standard is added requiring that access routes constructed by mining operations and intended for other than public use according to an approved reclamation plan be guarded, or locked, so that public access is prevented from private property.
- 17A. Present standards, as amended, are adequate.

18B. Present standards, as amended, are adequate.

19. Present standards, as amended, are adequate.

Part D: MONITORING PROGRAM

The proposed monitoring program of aggregate mining operations in Sonoma County is designed to provide additional mitigation of the significant adverse environmental effects associated with the extraction, processing, and transportation of aggregate materials. Most important, however, to the success of the proposed management plan is a systematic collection of management policies based on the new data. In addition, periodic monitoring and enforcement of operation and reclamation plans and standards is necessary to determine the effectiveness of standards and regulations as well as compliance by individual operations.

A number of the impacts identified in Section IV required monitoring as part of the available mitigation. Each of these aspects of the environment is included in the proposed monitoring activities described below and in the Appendix. A cost estimate is also included for the program.

All Mining Operations

Annual monitoring of mining activities will include the submittal of proprietary data by each operation. The information will consist of the quantity of material extracted, the type and quality of product sold, the method and route of transportation used to deliver products to market, the amount of energy consumed, and the quantities of material delivered to identified locations in the regional market. The information will be submitted by a time certain (no later than March 1 each year) to be specified in

the Surface Mining and Reclamation Ordinance, Section 26 A-6 of the County Code (see Appendix

A standard form for recording the data, similar to one developed by the U. S. Bureau of Mines currently in use by the industry, will be provided annually to each operator. The data will be used to monitor and adjust future demand forecasts, especially for out-of-county uses. A file will be provided under lock and key for the specific purpose of protecting the proprietary nature of the data. Any releases or publication of data submitted in this manner will be in summary form only.

The use of aggregate materials from Sonoma County sources will be further monitored using data collected periodically by other agencies. The State Board of Equalization monitors taxable retail sales for all building materials sold in the County, giving a general indication of the annual demand for construction materials. Residential and non-residential construction is monitored by each county in the regional market area. Finally, population estimates are made annually by the State Department of Finance and confirmed by federal and local decade and mid-decade censuses. Contacts have been established with these agencies for future receipt of this data.

Compliance on the part of individual mining operations with permit conditions, operation standards, and reclamation plans will be monitored during periodic site inspections. Hardrock quarries will be inspected at least once per month for the entire year. Inspection of terrace operations will occur weekly between April 1 and November 1 and biweekly between November 1 and April 1. Upon completion of the transition phase, monitoring will continue for reclamation activities, but at less frequent intervals. Instream operations will be visited weekly between May 1 and October 15, with occasional site visits during the winter months to inspect annual reclamation activities.

Hardrock Operations

In addition to the above information, monitoring of hardrock operations will also include measurements of groundwater supply and blasting operations, if applicable. Water table levels in wells used to supply water should be measured four times per year, during January, April, July, and October inspections. When blasting is necessary to loosen rock from hard-rock deposits, Planning staff will be notified two weeks in advance to ensure that neighboring property owners are made aware.

Instream and Terrace Operations

Monitoring of instream and terrace operations will also include land use, noise, hydrology, terrestrial and aquatic biology, groundwater supply and surface water quality.

1. Land Use:

Monitoring planned for five-year increments (decade and mid-decade census years) for updating the General Plan will provide adequate information on land use within the Alexander Valley, Dry Creek Valley, and the Middle Reach. Lands used for mining operations will be adequately monitored under hydrology.

2. Terrestrial and Aquatic Biology:

Annual monitoring of terrestrial and aquatic biology will include:

- 1) Study of the succession of developing riparian species on the gravel bars.
- 2) Periodic sampling of water temperature, turbidity, bed particle size, fish and insect populations.
- 3) Periodic checks on the progress of

terrace operation reclamation.

Current monitoring conducted by the Regional Water Quality Control Board supplemented with additional field work undertaken by a qualified biologist and coordinated with the Department of Fish and Game will adequately fulfill the monitoring requirements of this section, especially for water temperature and turbidity. An estimated 26 person-days of consultant labor is required primarily to sample fish and insect populations at five or six sites coincident with future instream mining operations.

3. Water Quality:

The ongoing program of monitoring water quality in the Russian River by the North Coast Regional Water Quality Control Board will provide adequate data for the purposes of this program. Parameters measured include:

- 1) Discharge
- 2) Temperature
- 3) ph
- 4) Conductivity
- 5) Turbidity
- 6) Dissolved Oxygen
- 7) Alkalinity
- 8) Nitrate
- 9) Total Kjeldahl Hydrogen
- 10) Total Phosphates
- 11) Algae Identification and Numberation
- 12) Chlorophyll A
- 13) Algae Growth Potential
- 14) Total and Fecal Coliform
- 15) Fecal Streptococci
- 16) Pseudomonas Aeruginosa

Water quality monitoring in the study area

is also conducted by the State Department of Water Resources. Data from both agencies is available to the Planning Division upon request.

Turbidity resulting from the placement of stream crossings used to access gravel bars will be monitored at the time of placement and removal by staff of the Planning Division, the Regional Water Quality Control Board, and the Department of Fish and Game. Operators will provide notice of these activities as discussed in Section VIII.B. (Operation Standards).

4. Groundwater Supply:

The depth of the water table below the surrounding land surface will be monitored once per month from May 1 to November 1 of each year for terrace operations. Measurements will be taken during January, April, July, and October inspections for hardrock operations.

5. Hydrology:

Monitoring of the hydrologic characteristics of the Russian River is proposed in order to:

- 1) Determine the hydrologic relationships of inchannel extraction to bedload replenishment, bank erosion, channel gradient and meander, and stream flow.
- 2) Establish limits on the quantities extracted from particular sites based on annual recharge.

Monitoring will consist primarily of biannual aerial surveys of the Russian River. These surveys will be

conducted prior to the commencement of instream operations in the spring and immediately following the conclusion of operations in the fall of each year. Vertical and horizontal control will be established for the survey flight so that accurate channel cross sectional data can be derived from the aerial photographs (see Flight Survey Specifications in Appendix

Additional data on streambank armoring, quantities extracted, and particle size for each gravel bar will be collected during periodic site inspections. Necessary stream flow data can be obtained upon request from the U. S. Geological Survey offices in Santa Rosa or Menlo Park. The combined data will be programmed and run on a computer model designed for the prediction of bedload scour and deposition. The HEC-6 model, developed by the U. S. Army Corps of Engineers, has been initially tested using hypothetical stream data for the Russian River in Alexander Valley. Preliminary indications are that the model will be useful in future predictions, within limits, of changes in bedload movement resulting from instream extraction in particular locations.

Further verification of the accuracy of the model's predictive ability will be accomplished during 1980. A work plan has been submitted to and approved by Sonoma County, the North Coast Regional Water Quality Control Board, and the State Water Resources Control Board. Pending final approval of the plan, drawn by Storm Engineering, by the Environmental Protection Agency, federal funding through water quality "208" channels will be forthcoming. The work plan calls for the model to be set up on a computer and run with actual stream channel cross-section data submitted during previous monitoring of individual operations. The predictions of the model can then be matched with the actual change in the streambed for a determination of the model's accuracy.

Assuming that the 1980 work shows that the model can be successfully applied to the Russian River system,

hydrologic data from the aerial survey will be processed once each year following the pre-extraction flight. Permitted extraction for that year's operation will be specified based on the previous winter's replenishment.

At present, the feasibility of the use of various computers is being investigated. The model will be set up on a computer, possibly the LBL 6700 at the Lawrence Berkeley Laboratory, for the verification study in 1980. Computers in current use in Sonoma County are also under consideration, including the IBM 360 at the County Data Processing Center. The Sonoma County Water Agency is presently conducting an evaluation of the computer requirements of the HEC-6 model as well as the capabilities of their in-house computer. It is proposed that, if feasible, the County computer facility, under the direction of Water Agency programming personnel, be used to process the annual monitoring data.

Cost Estimate

The monitoring program will require funding for staff, consultants, the aerial survey, and administration. The responsibilities of the staff planner would include collection and review of field data, coordination of the aerial flight and computer activities, and agency and consultant participation, and the handling of permits for future operations. This is in addition to the operation monitoring to be conducted by present zoning enforcement staff.

It is proposed that the estimated costs of the monitoring program be paid by all mining operations through annual inspection fees. The major cost of the program, hydrology and biology monitoring, would be paid by all operations in or abutting the river channel, each according to its portion of the channel.

The remainder of the costs would be borne by all operations in the same manner as the appropriation for this study. (See Appendix M) Table VII-1

shows the estimated cost of each part of the monitoring program.

Dry Creek

Monitoring of the Dry Creek channel by the U. S. Army Corps of Engineers will continue at previous cross section ranges until the completion of the Warm Springs Dam and Lake Sonoma Project. Proposals are currently being considered by the Water Agency and Corps of Engineers for streambank and streambed stabilization structures to be constructed as part of the project. At this time, however, no commitment for stream channel monitoring after the dam's completion has been made by the Corps of Engineers, although the Water Agency's ongoing gravel study (see Hydrologic History, Section II-B) measures cross section elevations at three ranges below the dam and should be adequate for determining the broad trend in channel buildup or degradation.

TABLE VII-1

<u>Item</u>	<u>Annual Cost</u>
1. Full time Planner II staff position	
salary	\$15,000.00
fringe, over-head, etc.	<u>7,500.00</u>
	<u>\$22,500.00</u>
2. Hydrology Monitoring	
a. Aerial survey (pre-extraction)	\$50,000.00
b. Aerial survey (post-extraction)	36,000.00
c. Computer (County facility)	500.00
d. Computer programmer	1,600.00
e. Hydrology consultant	<u>5,000.00</u>
	<u>\$ 93,100.00</u>
3. Biology Monitoring	\$ 1,750.00
TOTAL	<u><u>\$117,350.00</u></u>

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ENVIRONMENTAL IMPACT REPORT INDEX

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. . . .The proposed Aggregate Resources Management Plan identifies the quantity of aggregate materials necessary to meet demand for a period of fifty (50) years.

Estimates of demand are based on County General Plan projections. Since the Management Plan implements portions of the General Plan, questions of growth inducement have been addressed in that document.

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CALTRANS	"	"	"
"	"	"	"
"	"	"	"
"	"	"	"
"	"	"	"
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1. Bay Area Air Pollution Control District
2. Northern Sonoma County Air Pollution Control District
3. North Coast Regional Water Quality Control Board
4. California Department of Fish and Game
5. California Division of Mines and Geology
6. Sonoma County Project Review and Advisory Committee:
 - Sonoma County Road Department
 - Sonoma County Sanitation Department
 - Sonoma County Water Agency
 - Sonoma County Building Department

Sonoma County Department of Environmental
Health

Sonoma County Agricultural Commissioner

Sonoma County Surveyor

Sonoma County Farm Advisor

Sonoma County Planning Division

7. Sonoma County Department of Public Works
8. Sonoma County Water Agency
9. State Department of Water Resources
10. State Water Resources Control Board
11. U. S. Army Corps of Engineers

APPENDIX B

SOIL CLASS

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife. (None in Sonoma County.)

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

APPENDIX C

STORIE INDEX RATING

Four factors that represent the inherent characteristics and qualities of the soil are considered in the index rating. Each factor is rated or evaluated separately in terms of percentage of the ideal, or 100 percent. The factors are:

Factor A, Profile characteristics. Factor A expresses relative suitability of a profile for the growth of plant roots. Soils that have deep permeable profiles are rated 100 percent. Those that have a dense layer of clay or a hardpan or are shallow to bedrock are rated less than 100 percent. The rating depends upon the extent to which root penetration is limited.

Factor B, Texture of the surface soil. Factor B is rated according to the texture of the surface soil, which affects the ease of tillage and the capacity of the soil to hold water. The moderately coarse and medium textures--fine sandy loam, loam, and silt loam--are the most desirable and are rated as 100 percent. The coarser and finer textures, such as sand and clay, are rated less than 100 percent.

Factor C, Slopes. Factor C is particularly important if the soil is irrigated. The amount of water that runs off a soil and its susceptibility to erosion are influenced by the slope of the soil. Smooth, nearly level or very gently sloping soils are rated 100 percent. The rating decreases as the slope increases.

Factor X, Other conditions. Factor X is used to evaluate any limitations to use of the soil, such as poor drainage or a high water table, erosion, salts or alkali, low fertility, acidity, or unfavorable

microrelief. If more than one limitation exists, the values of each are multiplied together to get the X factor.

The index rating of a soil is obtained by multiplying the four factors, A, B, C, and X; thus, any one factor may dominate or control the final rating. For example, a soil may have an excellent profile justifying a rating of 100 percent for factor A, excellent texture of the surface soil justifying 100 percent for factor B, a smooth, nearly level surface justifying 100 percent for factor C, but a high accumulation of salts or alkali that would give a rating of 20 percent for factor X. Multiplying these four ratings gives an index rating of 20 for this soil. The high accumulation of salts or alkali dominates, makes the soil unproductive for crops, and justifies the low index rating of 20.

Soils are placed in grades according to their suitability for agricultural use as shown by their Storie index ratings. The six grades and their range in index ratings are:

	<u>Index Rating</u>
Grade 1-----	80 to 100
Grade 2-----	60 to 80
Grade 3-----	40 to 60
Grade 4-----	20 to 40
Grade 5-----	10 to 20
Grade 6-----	Less than 10

APPENDIX D

Rule 160

AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	California Standards ¹		National Standards ²		
		Concentration ³	Method ⁴	Primary ^{3, 5}	Secondary ^{3, 6}	Method ⁷
Oxidant (Ozone)	1 hour	0.10 ppm (200 ug/m ³)	Ultraviolet Photometry	160 ug/m ³ (0.08 ppm)	Same as Primary Std.	Chemiluminescent Method
Carbon Monoxide	12 hour	10 ppm (11 mg/m ³)	Non-Dispersive Infrared Spectroscopy	—	Same as Primary Standards	Non-Dispersive Infrared Spectroscopy
	8 hour	—		10 mg/m ³ (9 ppm)		
	1 hour	40 ppm (46 mg/m ³)		40 mg/m ³ (35 ppm)		
Nitrogen Dioxide	Annual Average	—	Saltzman Method	100 ug/m ³ (0.05 ppm)	Same as Primary Standards	Proposed: Modified J-H Saltzman (O ₃ corr.) Chemiluminescent
	1 hour	0.25 ppm (470 ug/m ³)		—		
Sulfur Dioxide	Annual Average	—	Conductimetric Method	80 ug/m ³ (0.03 ppm)	—	Pararosaniline Method
	24 hour	0.04 ppm (105 ug/m ³)		365 ug/m ³ (0.14 ppm)	—	
	3 hour	—		—	1300 ug/m ³ (0.5 ppm)	
	1 hour	0.5 ppm (1310 ug/m ³)		—	—	
Suspended Particulate Matter	Annual Geometric Mean	60 ug/m ³	High Volume Sampling	75 ug/m ³	60 ug/m ³	High Volume Sampling
	24 hour	100 ug/m ³		260 ug/m ³	150 ug/m ³	
Sulfates	24 hour	25 ug/m ³	AIHL Method No. 61	—	—	—
Lead	30 Day Average	1.5 ug/m ³	AIHL Method No. 54	—	—	—
Hydrogen Sulfide	1 hour	0.03 ppm (42 ug/m ³)	Cadmium Hydroxide Spectran Method	—	—	—
Hydrocarbons (Corrected for Methane)	3 hour (6.9 a.m.)	—	—	160 ug/m ³ (0.24 ppm)	Same as Primary Standards	Flame Ionization Detection Using Gas Chromatography
Ethylene	8 hour	0.1 ppm	—	—	—	—
	1 hour	0.5 ppm		—	—	—
Visibility Reducing Particles	1 observation	In sufficient amount to reduce the prevailing visibility to less than 10 miles when the relative humidity is less than 70%	(8)	—	—	—

NOTES:

- California standards are values that are not to be equaled or exceeded.
- National standards, other than those based on annual averages or annual geometric means, are not to be exceeded more than once per year.
- Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 mm of mercury. All measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 mm of Hg (1,013.2 millibar). ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.
- Any equivalent procedure which can be shown to the satisfaction of the Air Resources Board to give equivalent results at or near the level of the air quality standard may be used.
- National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health. Each state must attain the primary standards no later than three years after that state's implementation plan is approved by the Environmental Protection Agency (EPA).
- National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Each state must attain the secondary standards within a "reasonable time" after implementation plan is approved by the EPA.
- Reference method as described by the EPA. An "equivalent method" of measurement may be used but must have a "consistent relationship to the reference method" and must be approved by the EPA.
- Prevailing visibility is defined as the greatest visibility which is attained or surpassed around at least half of the horizon circle, but not necessarily in continuous sectors.

Rule 160

- (a) Notwithstanding the provisions of the Ambient Air Quality Standards proceeding, the standard for formaldehyde (HCHO), shall not exceed 0.1 ppm at any time, in the Ukiah, Little Lake Air Basin, as outlined in the appendix of this regulation.

UL-1 microgram I-8

APPENDIX E

AGGREGATE RESERVES

Sand and gravel reserves located within the Study area (Alexander Valley, Dry Creek Valley, and the Middle Reach between Healdsburg and Wohler Bridge) were calculated using the following information:

1. Aerial photographs
1940 Dry Creek and Middle Reach
1947 Alexander Valley
2. Well logs (1950's to present)
3. Aggregate industry drillings and estimates
4. Soil and subsoil descriptions of Soil Survey of Sonoma County (Soil Conservation Service)

Methodology (Terrace):

1. Using the aerial photographs, areas of "younger alluvium" or geologically recent stream activity were delineated as primary reserve areas.
2. Well logs which indicated * the presence or absence of sand and gravel reserves were located and mapped. (*Reserves were determined to exist if the usable portions of the drilling exceeded the total of overburden and unusable portions to a depth of 75 ft. (20 ft. water table and 55 ft. shovel capacity).)
3. The reserves boundaries were adjusted according to well log data. (In most cases, well logs confirmed boundaries set by mapping of younger alluvium.)
4. Adjustments were also made according to industry drillings and soil conditions.
5. Secondary reserves areas were delineated by well logs which indicated adequate reserves, but appeared to have a relatively higher content of clays and silts than the primary areas.
6. Primary reserves were calculated by multiplying the total number of acres times the number of tons of reserves per acre according to the formulas indicated on the accompanying chart.
7. Secondary reserves were calculated in a similar manner.
8. Urban areas were not included.
9. Sand and gravel reserves overlain by the Russian River or Dry Creek stream channel and its associated riparian growth were estimated separately.
10. Adjustments were made in the amounts of terrace reserves to compensate for property line setbacks (25 ft.) and subsurface pit slopes (1:1).
 - Assuming 100 acre pits surrounded by 25 ft. setback and 50 ft. pit depth below water, 9% material loss results (4% pit slope and 5% setback).
11. Acreages were measured with a planimeter from a 1:12,000 scale base map developed for the current study.
12. Measured reserves include areas where industry core drillings, well log data and geologic knowledge are available to such a degree that confident estimates of aggregate quality and quantity are possible.
13. Indicated reserves include areas which are geologically similar to measured reserves and for which well log data is available.

14. Inferred reserves include all areas for which geologic evidence and occasional well log data are the primary bases for estimates of quality and quantity.

Methodology (Instream):

1. "Instream" acreages include the live streambed, gravel bars, and portions of the riparian corridor not covered under terrace reserves.
2. A number of criteria were used to determine the depth and usability of reserves instream. These included geologic evidence, well log data, industry equipment capacity, and whether or not particular areas had been mined previously.
3. No adjustments were made for pit slopes or setbacks.
4. As in the section on terrace reserves, instream reserves were calculated to tons according to the accompanying chart.

Methodology (Crushed Rock Reserves):

A. Existing Sites

1. In most cases, reserves were computed for the entire property or properties where the excavation is located, minus final slope requirements.
2. Final slopes of 1.5:1 (horizontal run : vertical rise) were used, beginning at a point 25 ft. from property lines.
3. Pit floor elevations were assumed for each site. In most cases, these are the present floor elevations.
4. Usability of the reserves was assumed to be

100% (non-specification rock is usually sold as fill).

5. Existing quarry reserves are termed "inferred" reserves according to Bureau of Mines and Geology Survey terminology.
6. Computations were made with a planimeter from 1:6,000 scale base maps (USGS0. With these contour area measurements and contour intervals, reserves were computed in cubic yards using basic geometric formulae.
7. Reserves for quarries which are designated on the chart as borrow pits are not included in total reserves.

B. Potential Sites

1. Reserves for these sites are based on order-of-magnitude estimates by the consulting geologist. (See "TECHNICAL REPORT".)
2. Potential sites include those which were field surveyed by the geologist as well as several sites which were identified in his report but not field checked. No estimates of reserves are included for unvisited sites.

APPENDIX F
BIOTA OF THE STUDY AREA

Contents:

1. Flora
2. Terrestrial Fauna
3. Fishes
4. Aquatic Insects

1. Flora ("t" means tentative identification only.)

Plants are tabulated alphabetically by family under major headings. Common names are listed except where none exist. The primary habitat affinities are given according to the following symbols:

V = Vernal pool

M = Drainage basin margins and freshwater marsh

B = Gravel bars

F = Mature and late successional riparian forest

R = Redwood forest

O = Oak woodland and oak savanna (No extensive floristic study done. Many species in this list could be present in the community.)

Where no symbol is listed, there was no clear affinity for the plant.

<u>Species</u>	<u>Common Name</u>	<u>Habitat Affinity</u>
<u>Monocots</u>		
<u>Amaryllidaceae</u>		
<u>Brodiaea hyacinthina</u>	Wild hyacinth	V
<u>Allium sp.</u>	Wild onion	
<u>Cyperaceae</u>		
<u>Carex barbarae</u>	Basket sedge	F
<u>Carex nudata</u>	Sedge	M
<u>Carex spp.</u>	Sedge	M,V
<u>Cyperus eragrostis</u>	Umbrella sedge	M
<u>Heleocharis acicularis</u>	Spike-rush	V
(t) <u>Heleocharis macrostachya</u>	Spike-rush	M,V
<u>Scirpus microcarpus</u>	Bulrush or tule	M
<u>Scirpus sp.</u>	Bulrush or tule	M
<u>Gramineae</u>		
<u>Agrostis exarata</u>	Bent grass	B,M
<u>Agrostis palustris</u>	Creeping bent	B,M
<u>Aira caryophyllea</u>	Hairgrass	B
<u>Anthoxanthum odoratum</u>	Sweet vernal grass	B,M,V
<u>Arundo donax</u>	Giant reed	B,F
<u>Avena barbata</u>	Slender wild oat	B
<u>Briza maxima</u>	Quaking grass	B
<u>Briza minor</u>	Quaking grass	B,V
(t) <u>Bromus carinatus</u>	California brome	B
<u>Bromus diandrus</u>	Brome	B
<u>Bromus mollis</u>	Soft chess	B
<u>Bromus rubens</u>	Foxtail chess	B
<u>Bromus sp.</u>	Brome	B
<u>Cynodon dactylon</u>	Bermuda grass	B
(t) <u>Cynosurus echinatus</u>	Dogtail	B
<u>Dactylus glomerata</u>	Orchard grass	B
<u>Deschampsia danthonoides</u>	Hairgrass	M
<u>Deschampsia elongata</u>	Hairgrass	M

<u>Elymus glaucus</u>	Rye grass	B
<u>Festuca arundinacea</u>	Fescue	B,M
<u>Festuca megalura</u>	Foxtail fescue	B
<u>Gastridium ventri-</u> <u>cosum</u>		B
<u>Glyceria occidentalis</u>	Manna grass	V
<u>Hordeum arundinacea</u>	Barley grass	M
<u>Hordeum brachyan-</u> <u>therum</u>	Barley grass	B,M,V
<u>Hordeum geniculatum</u>	Barley grass	B,V
<u>Hordeum leporinum</u>	Barley grass	B
<u>Holcus lanatus</u>	Velvet grass	B,M
<u>Lolium multiflorum</u>	Italian ryegrass	B
<u>Lolium perenne</u>	Perennial ryegrass	B
<u>Melica sp.</u>	Melic grass	F
(t) <u>Paspalum distichum</u>	Knot grass	B,M
<u>Paspalum dilatatum</u>		B,M
(t) <u>Phalaris sp.</u>	Canary grass	B
<u>Poa annua</u>	Annual bluegrass	B
<u>Polypogon interruptus</u>	Beard grass	B,M,V
<u>Polypogon monspel-</u> <u>iensis</u>	Beard grass	B,M,V
<u>Sorghum halepense</u>	Johnson grass	B

Juncaceae

<u>Juncus sp.</u>	Rush	M
<u>Juncus bufonius</u>	Toad rush	M,V
<u>Juncus effusus var.</u> <u>pacificus</u>	Rush	M
<u>Juncus patens</u>	Rush	M
<u>Juncus phaeocephalus</u> <u>var. paniculatus</u>	Rush	V

Lilaeaceae

<u>Lilaea schilloides</u>	Flowering quillwort	M,V
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Liliaceae

<u>Chlorogalum pomeri-</u> <u>dianum</u>	Soapplant	B
<u>Disporum sp.</u>	Fairy bells	F,R

<u>Smilacina sp.</u>	Solomon's seal	R
<u>Trillium sp.</u>	Wake-robin	F,R

Typhaceae

<u>Typha latifolia</u>	Cattail	M
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Ferns and Fern Allies

Aspidiaceae

<u>Dryopteris arguta</u>	Wood fern	F,R
<u>Polystichum munitum</u>	Sword fern	R

Blechnaceae

<u>Woodwardia fimbriata</u>	Giant chain fern	M
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Equisetaceae

<u>Equisetum sp.</u>	Horsetail	M
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Polypodiaceae

<u>Polypodium</u> <u>californicum</u>	Polypody	F
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Pteridaceae

<u>Pityrogramma tri-</u> <u>angularis</u>	Goldenback fern	F
<u>Adiantum sp.</u>	Maidenhair fern	F,R
<u>Pteridium aquilinum</u> <u>var. pubescens</u>	Bracken fern	

Conifers

Pinaceae

<u>Pseudotsuga menziesii</u>	Douglas fir	R
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Taxodiaceae

Sequoia sempervirens Redwood R

Dicots

Aceraceae

Acer macrophyllum Big-leaf maple F

Acer negundo ssp. californicum Box elder F

Alismataceae

Alisma triviale Native waterplains M

Anacardiaceae

Rhus diversiloba Poison oak F

Apocynaceae

Vinca major Periwinkle F

Araliaceae

Hedera helix English ivy

Aristolochiaceae

Aristolochia californica Dutchman's pipe F

Asclepiadeceae

Asclepias eriocarpa Milkweed

Betulaceae

Alnus rhombifolia White alder M,F

Corylus cornuta var. californica California hazelnut R

Boraginaceae

Amsinchia intermedia Fiddleneck B

Heliotropium curassavicum var. oculatum Wild heliotrope B

Plagiobothrys bracteatus Marsh popcorn flower M,V

Plagiobothrys nothofulvus Popcorn flower B

Plagiobothrys stipitatus var. micranthus Popcorn flower B,V

Callitrichaceae

Callitriche marginata Water starwort V

Callitriche verna Water starwort V

Calycanthaceae

Calycanthus occidentalis Spicebush F

Campanulaceae

Campanula prenanthoides California harebell

Downingia concolor Wild lobelia V

Caprifoliaceae

Lonicera involucrata Twinberry F

Sambucus caerulea Elderberry B,F

Sambucus callicarpa Elderberry R

Symphoricarpos mollis Creeping snowberry F

Symphoricarpos uvularis Snowberry F

Caryophyllaceae

Cerastium viscosum Chickweed B

Silene gallica Windmill pink B

Silene sp. Catchfly B

<u>Spergula arvensis</u>	Spurry	B	<u>Lactuca saligna</u>	Wild lettuce	
<u>Spergularia sp.</u>	Sand-spurry	B	<u>Lactuca serriola</u>	Prickly lettuce	
<u>Stellaria media</u>	Chickweed	B	<u>Lactuca virosa</u>	Wild lettuce	
Chenopodiaceae			<u>Madia sp.</u>	Madia	
<u>Chenopodium sp.</u>	Pigweed	B	<u>Matricaria matricariodes</u>	Pineapple weed, chamomile	
<u>Salsola kali var. tenuifolia</u>	Russian thistle	B	<u>Picris echioides</u>	Ox tongue	
Ceratophyllaceae			<u>Psilocarphus sp.</u>		
<u>Ceratophyllum demersum</u>	Hornwort		<u>Senecio vulgaris</u>	Groundsel	B
Compositae			<u>Sonchus asper</u>	Sow thistle	B
<u>Achyrrachaena mollis</u>	Blow-wives		<u>Taraxacum officinale</u>	Common dandelion	
<u>Ambrosia psilostachya</u>	Western ragweed		<u>Xanthium spinosum</u>	Spiny clotbur	B
<u>Anthemis cotula</u>	Mayweed	B	<u>Xanthium strumarium</u>	Cocklebur	B,M
<u>Artemisia douglasiana</u>	Wormwood	B,F	Convolvulaceae		
<u>Artemisia sp.</u>	Wormwood	B	<u>Convolvulus sp.</u>	Morning glory	B
<u>Baccharis douglasii</u>		F	Cornaceae		
<u>Baccharis pilularis</u>	Coyote brush	B,F	<u>Cornus sp.</u>	Dogwood	F
<u>ssp. consanguinea</u>			Cruciferae		
<u>Baccharis sp.</u>		F	<u>Brassica campestris</u>	Field mustard	B
<u>Baccharis viminea</u>	Mule fat	B	(t) <u>Brassica geniculata</u>	Wild mustard	B
<u>Blennosperma nanum</u>	Blennosperma	B,M	<u>Brassica nigra</u>	Black mustard	B
<u>Carduus pycnocephalus</u>	Italian thistle		<u>Capsella bursa-pastoris</u>	Shepherd's purse	
<u>Centaurea sp.</u>	Star thistle	B	<u>Cardamine oligosperma</u>	Bitter-cress	B,M,F
<u>Conyza canadensis</u>	Fleabane	B,M	<u>Draba verna</u>	Whitlow-grass	B,M
<u>Crysopsis oregona</u>	Golden aster	B	<u>Lepidium sp.</u>	Pepper-grass	
<u>Crepis sp.</u>	Hawksbeard		<u>Nasturtium officinale</u>	Watercress	M
<u>Eriophyllum lanatum</u>	Woolly sunflower		<u>Raphanus sativus</u>	Wild radish	B
<u>var. achillaeoides</u>			<u>Rorippa curvisiliqua</u>	Yellow cress	M,V
<u>Eriophyllum lanatum</u>	Woolly sunflower	B	<u>Sisymbrium sp.</u>		
<u>var. arachnoideum</u>			<u>Streptanthus glandulosus</u>	Jewel flower	B
<u>Gnaphalium chilense</u>	Cudweed	B	Cucurbitaceae		
<u>Hemizonia sp.</u>	Tarweed	O	<u>Marah fabaceus</u>	Wild cucumber	B,F
<u>Hieracium sp.</u>	Hawkweed	F			
<u>Helenium puberulum</u>	Sneezeweed	M			
<u>Hypochoeris radicata</u>	Cat's ear	B			

Ericaceae

<u>Arbutus menziesii</u>	Madrone	F,O
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Euphorbiaceae

<u>Eremocarpus setigerus</u>	Doveweed	B
<u>Euphorbia lathyris</u>	Caper spurge	B
<u>Euphorbia peplus</u>	Petty spurge	B
<u>Euphorbia sp.</u>	Spruge	B

Fagaceae

<u>Quercus agrifolia</u>	Coast live oak	F
<u>Quercus kelloggii</u>	California black oak	F
<u>Quercus lobata</u>	Valley oak	F

Geraniaceae

<u>Erodium botrys</u>	Filaree	B
<u>Erodium cicutarium</u>	Filaree	B
<u>Erodium obtusi-</u> <u>plicatum</u>	Filaree	B
<u>Geranium molle</u>	Geranium	B
<u>Geranium pilosum</u>	Geranium	B

Hippocastanaceae

<u>Aesculus californica</u>	California buckeye	F
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Hydrophyllaceae

<u>Nemophila menziesii</u>	Baby blue-eyes	B
<u>Nemophila menziesii</u>	Baby blue-eyes	B
<u>ssp. atomaria</u>		
<u>Eriodictyon californ-</u> <u>icum</u>	Yerba santa	
(t) <u>Phacelia sp.</u>		

Hypericaceae

<u>Hypericum perforatum</u>	Klamath weed	
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Juglandaceae

<u>Juglans hindsii</u>	California black walnut	F
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Hydrocharitaceae

<u>Elodea sp.</u>	Waterweed	M
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Labiatae

<u>Lamium sp.</u>	Henbit	
<u>Marrubium vulgare</u>	Horehound	B
<u>Mentha pulegium</u>	Pennyroyal	M
<u>Monardella villosa</u>	Coyote mint	
<u>Pogogyne serpylloides</u>		B
<u>Stachys chamissonis</u>	Coast hedge-nettle	F
<u>Stachys sp.</u>	Hedge-nettle	F
<u>Trichostema sp.</u>	Bluecurls	B

Lemnaceae

<u>Lemna sp.</u>	Duckweed	M
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Lauraceae

<u>Umbellularia californica</u>	California bay-laurel	F,R
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Leguminosae

<u>Lotus corniculatus</u>	Bird's foot trefoil	B
<u>Lotus humistratus</u>	Hill lotus	B
<u>Lotus subpinnatus</u>	Chile trefoil	B
<u>Lupinus bicolor</u>	Dove lupine	B
<u>Lupinus succulentus</u>	Lupine	B
<u>Medicago arabica</u>	Spotted medic	B
<u>Medicago hispida</u>	Bur-clover	B
<u>Medicago hispida var.</u> <u>confinus</u>	Bur-clover	B
<u>Medicago sativa</u>	Alfalfa	B
<u>Melilotus albus</u>	White sweet clover	B
<u>Melilotus indicus</u>	Yellow sweet clover	B

<u>Psoralea physodes</u>	California tea				
<u>Trifolium fucatum</u>	Bull clover	B			
<u>Trifolium incarnatum</u>	French clover	B			
<u>Trifolium tridentatum</u>	Tomcat clover	B			
(t) <u>Trifolium microcephalum</u>	Maiden clover	B			
<u>Vicia angustifolia</u>	Narrow-leaved vetch	B,V			
<u>var. segetalis</u>					
<u>Vicia californica</u>	Vetch	B			
Limnanthaceae					
<u>Limnanthes douglasii</u>	Meadow foam	B,M			
<u>var. nivea</u>					
Loranthaceae					
<u>Phorodendron tanen-</u>	Mistletoe	O			
<u>tosum ssp. macro-</u>					
<u>phyllum</u>					
Lythraceae					
<u>Lythrum hyssopifolia</u>	Loosestrife	M,V			
Malvaceae					
<u>Malva sp.</u>	Cheeseweed				
<u>Sidalcea diplo-</u>	Annual checker	B			
<u>scypha</u>					
Oleaceae					
<u>Fraxinus latifolia</u>	Oregon ash	F			
Onagraceae					
<u>Clarkia concinna</u>	Red ribbons	B			
<u>Epilobium sp.</u>	Willow-herb	B			
<u>Jussiaea repens var.</u>		M			
<u>peplodes</u>					
<u>Oenothera micrantha</u>	Evening primrose	B			
<u>var. jonesii</u>					
<u>Oenothera ovata</u>	Sun-cups	B			
Papavaraceae					
<u>Eschscholzia califor-</u>	California poppy	B			
<u>nica</u>					
<u>Platystemon califor-</u>	Cream cups	B			
<u>nica</u>					
Plantaginaceae					
<u>Plantago hirtella</u>	Plantain				
<u>var. galeottiana</u>					
<u>Plantago lanceolata</u>	Buckhorn	B			
Polemoniaceae					
<u>Gilia capitata</u>	Globe gilia	B			
<u>Gilia tricolor</u>	Bird's eyes	B			
<u>Linanthus sp.</u>	Wild phlox				
<u>Navarretia sp.</u>		B			
Polygonaceae					
<u>Eriogoneum sp.</u>	Wild buckwheat				
<u>Polygonum sp.</u>	Smartweed	M			
<u>Rumex acetosella</u>	Sheep sorrel	B,M			
<u>Rumex crispus</u>	Curly dock	B,M			
<u>Rumex pulcher</u>	Fiddle dock	B,M,V			
Portulacaceae					
<u>Calandrinia ciliata</u>	Red maids	B,M			
<u>var. menziesii</u>					
<u>Montia perfoliata</u>	Miner's lettuce	B			
<u>Montia perfoliata</u>	Miner's lettuce	B			
<u>forma</u>					
Primulaceae					
<u>Anagallis arvensis</u>	Scarlet pimpernel	B			
<u>Trientalis latifolia</u>	Star flower				

Ranunculaceae

<u>Clematis ligustici-</u> <u>cifolia</u>	Virgin's bower	B,F
<u>Ranunculus muricatus</u>	Buttercup	B,V
<u>Ranunculus pusillus</u>	Dwarf buttercup	B,V
<u>Ranunculus sp.</u>	Buttercup	B,V
<u>Thalictrum poly-</u> <u>carpum</u>	Meadow rue	

Rhamnaceae

<u>Ceanothus sp.</u>	Ceanothus	
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Rosaceae

<u>Heteromeles ar-</u> <u>butifolia</u>	Toyon	
<u>Physocarpus capitatus</u>	Ninebark	F
<u>Potentilla californi-</u> <u>nica</u>	Cinquefoil	B
<u>Prunus sp.</u>		
<u>Rosa californica</u>	California wild rose	B,F
<u>Rosa eglantaria</u>	Sweet briar	F
<u>Rosa gymnocarpa</u>	Wood rose	F
<u>Rubus discolor</u>		F
<u>Rubus ursinus</u>	California black- berry	F

Rubiaceae

<u>Galium parisiense</u>	Bedstraw	F
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Salicaceae

<u>Populus fremontii</u>	Cottonwood	B,F
<u>Salix hindsiana</u>	Sandbar willow	B,F
<u>Salix laevigata</u>	Red willow	B,M,F
<u>Salix lasiandra</u>	Yellow willow	B,M,F
<u>Salix lasiolepis</u>	Arroyo willow	B,F
<u>Salix sp.</u>	Willow	B,M

Saxifragaceae

<u>Ribes sp.</u>	Gooseberries and currants	F
<u>Whipplea modesta</u>	Modesty	F,R

Scrophulariaceae

<u>Collinsia corymbosa</u>		B
<u>Collinsia sp.</u>		B
<u>Gratiola ebracteata</u>	Hedge-hyssop	V
<u>Mimulus aurantiacus</u>	Bush monkeyflower	
<u>Mimulus guttatus</u>	Yellow monkeyflower	M,V
<u>Mimulus pilosus</u>	Viscid monkeyflower	B
<u>Orthocarpus faucibar-</u> <u>batus</u>	Yellow owl's clover	V
<u>Orthocarpus pusillus</u>	Dwarf owl's clover	
<u>Orthocarpus sp.</u>	Owl's clover	
<u>Parentucellia viscosa</u>		B
<u>Scrophularia californicum</u>	Figwort	F
<u>Verbascum blattaria</u>	Moth mullein	B
<u>Verbascum thapsus</u>	Common mullein	B
<u>Verbascum virgatum</u>	Mullein	B
<u>Veronica anagallis-</u> <u>aquatica</u>	Speedwell	M
<u>Veronica peregrina</u> <u>ssp. xalapensis</u>	Speedwell	B,M,V

Solanaceae

<u>Datura sp.</u>	Jimson weed	B
<u>Nicotiana bigelovii</u>	Tobacco	B
<u>Solanum sp.</u>	Nightshade	

Tamaricaceae

<u>Tamarix sp.</u>	Tamarix	B,F
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Umbelliferae

(t) <u>Anthriscus scan-</u> <u>dicina</u>	Bur-chervil	
<u>Conium maculatum</u>	Poison hemlock	F

	<u>Foeniculum vulgare</u>	Fennel	
	<u>Heracleum lanatum</u>	Cow-parsnip	F
(t)	<u>Sanicula crassicaulis</u>	Gambelweed	
	<u>Scandix pecten-</u> <u>veneris</u>	Shepherd's needle	
(t)	<u>Torilis sp.</u>	Hedge-parsley	

Urticaceae

	<u>Urtica holosericea</u>	Stinging nettle	F
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Verbenaceae

	<u>Lippia nodiflora</u>		V
	<u>var. cosea</u>		
	<u>Verbena lasiostachys</u>	Verbena	B

Vitaceae

	<u>Vitis californica</u>	Wild grape	F
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2.

TERRESTRIAL ANIMAL
SPECIES/COMMUNITY LIST

The presence of a species in a community is based upon evidence observed during this field study and is not inferred from natural histories.

The level of activity within a community is denoted by the following:

- P - present: at minimal the animal moves through the community, but probably utilizes the habitat to a greater extent
- F - feeds: evidence of feeding in the community
- B - breeds: evidence of breeding in the community

Classification of communities is based upon the following:

River - the flowing river and its immediate banks

Gravel Bars

- A. Open floodplain - fine to coarse gravel deposits with varying amounts of sand and occasional "pavement" formations, sparsely vegetated with annuals
- B. Hydric - quiescent backwaters of the river, swales with overflow pools and intermittent drainages

Sand Bars - thin strands of mule fat and/or young cottonwood/willow to dense clusters of medium growth cottonwood/willow on sand hummocks

Artemisia Bench - growth to 1.5 meters dominated by Artemisia sp.

Forest

- A. Flood zone - young, uniform, monotypic stand of willows, no brush layer, no ground cover, much flood debris of leaves, twigs, branches, trees
- B. Stratified woodland - overstory of mature cottonwoods, understory of box elder and walnut, dense brush layer, hanging vines of wild grape, grassy/herbaceous margins along trails
- C. Unstratified woodland - one canopy of box elder and walnut, little brush layer, dense periwinkle ground cover

D. Gravel pit - steep-sided pit with shallow to deep water and occasional patches of dense young Salix sp. at the water's edge

AMPHIBIANS

Western Toad
Bufo boreas

Pacific Treefrog
Hyla regilla

Bullfrog
Rana catesbeiana

REPTILES

Western Pond Turtle
Clemmys marmorata

Western Fence Lizard
Sceloporus occidentalis

Gopher Snake
Pituophis melanoceus

Western Aquatic Garter Snake
Thamnophis couchi
aquaticus

Common Garter Snake
Thamnophis sirtalis
infernalis

EVIDENCE	RIVER	OPEN FLOODPLAIN	HYDRIC	SANDBAR	GRAVEL BAR		FLOOD ZONE	STRATIFIED WOODLAND	FOREST	
sight	PB	P	B	P						
sight		P	P							
sight			B						B	
sight	P									
sight		P		P	P		P	P		
sight				P						
sight			P							
sight							P			

Notes on Bird List

Affinity - scale of breeding densities
in riparian habitat as com-
pared to other habitats:
1 = highest density; 8 = species
breeds in greater density in 7
other habitats

w/y - observed with young

* - insufficient data

BIRD SPECIES

Double-crested Cormorant
Great-blue Heron
Green Heron
Black-crowned Night Heron
Mallard
Wood Duck
Greater Scaup
Common Merganser
Turkey Vulture
White-tailed Kite
Sharp-shinned Hawk
Cooper's Hawk
Red-tailed Hawk
Red-shouldered Hawk
Osprey
Peregrine Falcon
*Merlin
American Kestrel
California Quail
*Ring-necked Pheasant
Killdeer
Black-bellied Plover
Greater Yellowlegs
Spotted Sandpiper
Dunlin
California Gull
Ring-billed Gull
Caspian Tern
Rock Dove
Mourning Dove

			GRAVEL BARS				FOREST				
			OPEN FLOODPLAIN	HYDRIC	SANDBAR	ARTEMISIA BENCH	FLOOD ZONE	STRATIFIED WOODLAND	UNSTRATIFIED WOODLAND	GRAVEL PIT	AFFINITY
overhead											
	F	F	F	P			B		P	2	
		F	F							1	
		P	P								
w/y	P	P									
	P						P			1	
	P										
w/y	P									1	
		P	overhead								
		overhead					B				
		overhead					P				
		overhead					P				
		overhead					P				
		overhead					B				
	F		overhead				B				
		overhead									
	P	P	overhead							4	
		F		F	F	P	F	F		3	
		BF		F					P		
									P		
		P									
		F								1	
		overhead									
		overhead									
		overhead									
									P		
		F	F								
		F		B			BF			2	

[illegible]

BIRD SPECIES	RIVER	GRAVEL BARS					FOREST		
		OPEN FLOODPLAIN	HYDRIC	SANDBAR	ARTEMISIA BENCH	FLOOD ZONE	STRATIFIED WOODLAND	UNSTRATIFIED WOODLAND	GRAVEL PIT
House Wren						BF			4
Winter Wren						P			
Bewicks Wren	F		F			BF			4
California Thrasher	F		F	F					
American Robin			F			BF	BF		
*Hermit Thrush									
Swainson's Thrush	F		F	P		BF	P	P	1
Western Bluebird	F	G	F			BF			2
*Ruby-crowned Kinglet									
Cedar Waxwing						P			
Starling			BF			BF	P	P	4
Hutton's Vireo						F	F		
Solitary Vireo						BF	F		
Warbling Vireo					P	BF	P		3
Orange-crowned Warbler			BF		F	BF	F		5
*Nashville Warbler									
Yellow Warbler	P					BF			1
*Yellow-rumped Warbler									
*McGillvary's Warbler									
Common Yellowthroat			BF				P		
Yellow-breasted Chat			P	P		BF			1
Wilson's Warbler						BF	F		4
Western Meadowlark						P			
Red-winged Blackbird						P			
Northern Oriole									
Brewer's Blackbird			P						3
Brown-headed Cowbird	F	F	P			BF			2
Black-headed Grosbeak			P		P	P	P		4
Lazuli Bunting	P		F			BF	BF		4
Purple Finch						P			
House Finch						P			
American Goldfinch	F		P	F		P			

BIRD SPECIES	GRAVEL BARS										FOREST	
	RIVER	OPEN FLOODPLAIN	HYDRIC	SANDBAR	ARTEMISIA	BENCH	FLOOD ZONE	STRATIFIED WOODLAND	UNSTRATIFIED WOODLAND	GRAVEL PIT	AFFINITY	
Lesser Goldfinch		F	F	F	F		P			3		
Rufous-sided Towhee		F	F	F	F					3		
Brown Towhee				F			BF			5		
Lark Sparrow		F		F			BF			6		
*Dark-eyed Junco		F					P	P		4		
Chipping Sparrow												
*White-crowned Sparrow					F		F	F				
*Golden-crowned Sparrow												
*Fox Sparrow												
*Lincoln Sparrow												
Song Sparrow		F		F	F	F	BF	F		4		

Winter Bird Observations
(Preliminary float trip 11/78 and 12/1/78)

Great-blue Heron
Green Heron
Great Egret
Snowy Egret
Mallard
Wood Duck
Common Merganser
Turkey Vulture
Sharp-shinned Hawk
Cooper's Hawk
Red-tailed Hawk
Osprey
Peregrine Falcon
American Kestrel
Killdeer
Spotted Sandpiper
Brewer's Blackbird

Ring-billed Gull
Belted Kingfisher
Common Flicker
Black Phoebe
Scrub Jay
Common Raven
Common Crow
Dipper
Bewick's Wren
American Robin
Western Bluebird
Ruby-crowned Kinglet
Starling
Yellow-rumped Warbler
Brown Towhee
Song Sparrow

Butterflies of the Russian River

Pipe-vine Swallowtail
Western Tiger Swallowtail
Sara Orange Tip
Cabbage Butterfly
Western Meadow
Common Checkerspot
Buckeye
Mourning Cloak
Lorquin's Admiral
California Sister
Great Purple Hairstreak
Purplish Copper
California Ringlet
Silver-spotted Skipper
Mournful Duskywing

Battus philenor
Papilio rutulus
Anthocaris sara
Pieris rapae
Boloria epithore
Euphydryas calcedona
Junonia coenia
Nymphalis antiopa
Limenitis lorquini
Limenitis bredowii
californica
Atliades halesus
Lycaena helloides
Coenonympha californica
Epargyreus clarus
Erynnis tristis

MAMMALS	EVIDENCE	RIVER	OPEN FLOODPLAIN	GRAVEL BARS			FOREST		
				HYDRIC	SANDBAR	ARTEMISIA BENCH	FLOOD ZONE	STRATIFIED WOODLAND	UNSTRATIFIED WOODLAND
Opossum <u>Didelphis marsupialis</u>	sight						P		
Broad-handed Mole <u>Scapanus latimanus</u>	sign			P	P	P	P	P	P
Black-tailed Hare <u>Lepus californicus</u>	sight	F		F			P	P	
Brush Rabbit <u>Sylvilagus bachmani</u>	sight			F	F		F	F	
Western Gray Squirrel <u>Sciurus griseus</u>	sight			F			F	F	
Botta Pocket Gopher <u>Thomomys bottae</u>	sign						P		P
Western Harvest Mouse <u>Reithrodontomys megalotis</u>	sight			P				P	
Deer Mouse <u>Peromyscus maniculatus</u>	sight	P		P	P	P	P	P	P
Dusky-footed Wood Rat <u>Neotoma fuscipes</u>	sight			B		B	B		
California Meadow Mouse <u>Microtus californicus</u>	sight				P			P	P
House Mouse <u>Mus musculus</u>	sight						F		

MAMMALS	EVIDENCE	GRAVEL BARS							FOREST
		RIVER	OPEN FLOODPLAIN	HYDRIC	SANDBAR	ARTEMISIA BENCH	FLOOD ZONE	STRATIFIED WOODLAND	
Coyote <u>Canis latrans</u>	report/ sign	P (re- ported)	P swimming)						
Gray Fox <u>Urocyon cinereoargenteus</u>	sign	P					P	P	
Ringtail <u>Bassaricus astutus</u>	report						P (reported breeding - 1972)		
Raccoon Pro <u>Procyon lotor</u>	sight	F	P	F		P	P	P	P
Mink <u>Mustela vison</u>	report	P (reported north of study area re- cently and in study area histor- ically)							
Badger <u>Taxidea taxus</u>	sign	(present in grassy meadow along river's edge)							
Striped Skunk <u>Mephitis mephitis</u>	sight						P	P	
River Otter <u>Lutra canadensis</u>	report/ sign	B (recent reported sightings as well as tracks)							
Black-tailed Mule Deer <u>Odocoileus hemionus col- umbianus</u>	sight	F		P		P	B		P

3.

FISHES OF THE RUSSIAN RIVER SYSTEM*

<u>Family</u>	<u>Common Name</u>	<u>Habitat Affinity</u>
Petromyzontidae	Lampreys	
<u>Lampetra ayresii</u>	River lamprey	A,N
<u>L. pacifica</u>	Coastrange brook lamprey	R,N
<u>L. tridentata</u>	Pacific lamprey	A,N
Acipenseridae	Sturgeons	
<u>Acipenser medirostris</u>	Green sturgeon	A,N
<u>A. transmontanus</u>	White sturgeon	A,N
Clupeidae	Herrings	
<u>Alosa sapidissima</u>	American shad	A,I
<u>Clupea pallasii</u>	Pacific herring	E,N
Engraulidae	Anchovies	
<u>Engraulis mordax</u>	Northern anchovy	E,N
Osmeridae	smelts	
<u>Hypomesus pretiosus</u>	Surf smelt	E,N
Salmonidae	Trouts	
<u>Oncorhynchus gorbuscha</u>	Pink salmon	A,N
<u>O. kisutch</u>	Coho or silver salmon	A,N
<u>O. tshawytscha</u>	Chinook or king salmon	A,N
<u>Salmo gairdnerii</u>	Steelhead or rainbow trout	A or R,N
<u>S. trutta</u>	Brown trout	R,I

Cyprinidae

<u>Carassius auratus</u>	Goldfish	R,I
<u>Cyprinus carpio</u>	Carp	R,I
<u>Hesperoleucus symmetricus</u>	California roach	R,N
<u>Lavinia exilicauda</u>	Hitch	?I,R
<u>Mylopharodon conocephalus</u>	Hardhead	R,N
<u>Orthodon microlapidotus</u>	Sacramento blackfish	?I,R
<u>Ptychocheilus grandis</u>	Sacramento squawfish	R,N

Minnows

Catostomidae

<u>Catostomus occidentalis</u>	Sacramento sucker	R,N
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Suckers

Ictaluridae

<u>Ictalurus catus</u>	White catfish	I,R
<u>I. melas</u>	Black catfish	?I,R
<u>I. nebulosus</u>	Brown catfish	I,R
<u>I. punctatus</u>	Channel catfish	I,R

Catfishes

Poeciliidae

<u>Gambusia affinis</u>	Topsmelt	E,N
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Livebearers

Atherinidae

<u>Atherinops finis</u>	Topsmelt	E,N
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Siversides

* List compiled from Hopkirk, 1979; Hubbs, Follett and Dempster, 1979; Moyle, 1976. A = anadromous; I = introduced; E = estuarine; R = resident or non-migrator; N = native to the Russian River; ? = possibly present.

Gasterosteidae	Sticklebacks		Gobiidae	Gobies	
<u>Gasterosteus aculeatus</u>	Threespine stickleback	A,N	<u>Clevelandia ios</u>	Arrow goby	E,N
			(?) <u>Acanthogobius flavimanus</u>	Yellowfin goby	I,E
Syngnathidae	Pipefishes		(?) <u>Eucyclogobius newberryi</u>	Tidewater goby	E,N
<u>Syngnathus leptorhynchus</u>	Bay pipefish	E,N			
			Pleuronectidae	Righteyed flounders	
Cottidae	Sculpins		<u>Platichthys stellatus</u>	Starry flounder	E,N
<u>Cottus aleuticus</u>	Coastrange sculpin	R,N			
<u>C. asper</u>	Prickly sculpin	R,N			
<u>C. gulosus</u>	Riffle sculpin	R,N			
<u>Leptocottus armatus</u>	Staghorn sculpin	E,N			
Serranidae	Sea basses				
<u>Roccus saxatilis</u>	Striped bass	A,I			
Centrarchidae	Sunfishes				
<u>Archoplites interruptus</u>	Sacramento perch	?I,R			
<u>Lepomis cyanellus</u>	Green sunfish	I,R	<u>Cinygma</u>	Primary tributary; riffle	
<u>L. macrochirus</u>	Bluegill	I,R	<u>Heptagenia</u>	Primary tributary; riffle	
<u>L. microlophus</u>	Redear sunfish	I,R	<u>Ironodes californicus</u>	Primary tributary; riffle	
<u>Micropterus dolomieu</u>	Smallmouth bass	I,R	<u>Iron albertae</u>	Main stream; riffle	
<u>M. salmoides</u>	Largemouth bass	I,R			
(?) <u>Pomoxis annularis</u>	White crappie	I,R			
<u>P. nigromaculatus</u>	Black crappie	I,R			
Embistocidae	Surfperches				
<u>Cymatogaster aggregata</u>	Shinerperch	E,N			
<u>Hysterocarpus traskii</u>	Russian River tuleperch	R,N			

4. AQUATIC INSECTS IDENTIFIED FROM BOTTOM SAMPLES

Order EPHEMEROPTERA (mayflies)

Family Heptageniidae (stream mayflies)

<u>Cinygma</u>	Primary tributary; riffle
<u>Heptagenia</u>	Primary tributary; riffle
<u>Ironodes californicus</u>	Primary tributary; riffle
<u>Iron albertae</u>	Main stream; riffle

Family Baetidae (small mayflies)

<u>Serrata tibialis</u>	Primary tributary; riffle
<u>Isonychia velma</u>	Primary tributary; riffle

Order ODONATA (dragonflies and damselflies)

Suborder ANISOPTERA (dragonflies)

Family Gomphidae (club-tailed dragonflies)

<u>Hagenius</u>	Primary tributary; riffles and pools
<u>Erpetogomphus compositus</u>	Primary tributary; pools

Family Aeshnidae (common darners)

Anax junius Main stream; lentic-side
channel

Family Libellulidae (skimmers)

Helocordula Main stream; pool
Pseudoleon sup- Main stream; lentic-side
erbus channel

Suborder ZYGOPTEA (damselflies)

Family Agrionidae (broad-winged damselflies)

Hetaerina amer- Main stream; pool
icana

Family Lestidae

Lestes unguicu- Main stream; lentic-side
latus channel

Family Coenagrionidae

Chromagrion Main stream; lentic-side
channel
Amphiagrion ab- Main stream; pool
breviatum

Order PLECOPTERA (stoneflies)

Family Nemouridae (spring stoneflies)

Isocapnia grandis Primary tributary; riffle

Order PEMIPTERA (true bugs)

Family Corixidae (water boatmen)

Graptocorixa cal- Main stream; lentic-side
ifornica channel

Family Naucoridae (creeping water bugs)

Ambrysus mormon Mainstream; pool and
lentic-side channels

Family Belostomatidae (giant water bugs)

Belostoma flumin- Mainstream; lentic-side
eum channels

Family Nepidae (water scorpions)

Ranatra brevi- Main streams; lentic-
collis side channels

Order COLEOPTERA (beetles)

Family Psephenidae (Water-penny beetles)

Psephenus hal- Main stream; riffle
demani

Order TRICHOPTERA (caddis flies)

Family Hydropsychidae (net-spinning caddis flies)

Diplectrona Main stream-riffle;
primary tributary-
riffle

APPENDIX G

ARTICLE 5. MINERAL RESOURCE DISTRICT

Section 26-50. Purpose

To conserve and protect land that is necessary for future mineral resource production. Land use which is consistent with long-term utilization of mineral resources is allowed, while uses which may be incompatible with such utilization are restricted. The MR District is to be applied within areas designated "Managed Resource" by the General Plan. Applications for rezoning to the MR District are to be noticed, heard, and determined by the Planning Commission in the manner provided for in Article XXX.

Section 26-51. Uses Permitted Subject to Site Development and Sensitive Area Regulations

The following uses are permitted except within a sensitive area, riparian corridor, scenic corridor, area of critical habitat, or unique feature designated in the General Plan or a Specific Plan (see Section 26-52, Use Permits, when these uses are located within the above areas of concern). All clearing of vegetation, grading, excavation, fill or construction in association with these uses shall conform to the Site Development Standards (Section 26-53).

(a) RESOURCE MANAGEMENT

1. Geotechnical studies involving no grading or construction of new roads of pads.

2. Livestock farming, including the raising, grazing, maintaining and breeding of horses, cattle, sheep, goats, and similar livestock

3. The outdoor growing and harvesting of shrubs, plants, flowers, trees, vines, fruits, vegetables, hay, grain, and similar food and fiber crops, including packing, polishing and the like of unprocessed agricultural yield grown on the premises.

4. Timber management, including planing, raising, and harvesting of trees for timber (subject to the requirements of the California Division of Forestry).

5. Wildlife preserves and refuges.

(b) RESIDENTIAL USES

1. One single-family dwelling and one guest house per lot.

(c) RECREATIONAL USES

1. Hiking, hunting, boating, or fishing.

(d) INCIDENTAL USES

1. Accessory structures or uses incidental and appurtenant to any permitted uses, including barns, sheds and corrals.

2. Accessory structures, or uses incidental and appurtenant to a single-family dwelling, including:

- a. Home occupations

- b. Hobby greenhouses up to 1000 square feet in floor area.

- c. Day care centers, and preschools for six or few persons.
- d. The raising, feeding, maintaining, and breeding of poultry fowl, rabbits, fur-bearing animals, and the like, for use of consumption by the persons residing on the property.
- e. Non-commercial kennels for up to ten dogs.
- f. Non-commercial stables.

(e) *SIGNS*

- 1. Appurtenant signs subject to Article 33, Sign Regulations, and Article 42, Design Review.

Section 26-52: Uses Requiring a Use Permit or a Use Permit Waiver

(a) *SENSITIVE AREA USES*

- 1. Permitted uses listed in Section 26-51 when located within a sensitive area, riparian corridor, scenic corridor, area of critical habitat, or unique feature designated in the General Plan or a Specific Plan.
- 2. Any clearing of vegetation, grading excavation, fill or construction when located within a sensitive area, riparian corridor, scenic corridor, area of critical habitat or unique feature designated in the General Plan or a Specific Plan.

(b) *RESOURCE MANAGEMENT*

- 1. Mineral extraction and production

(subject to the provisions of the Surface Mining and Reclamation Ordinance, Chapter 26A, Sonoma County Code) including:

- a. Hardrock quarry operations: Crushed rock operations which entail the extraction, stockpiling, processing and sale of in situ rock, overburden, and topsoil.

Asphalt batch plants incidental to hardrock quarries.

Cement concrete batch plants incidental of hardrock quarries.

Equipment storage yards incidental to resource management, including parking, repairing and storage of equipment so used.

Accessory structures, offices or other uses incidental to hardrock quarry operations.

- b. River terrace operations: Sand and gravel operations which entail the extraction, stockpiling, processing and sale of sand, gravel, overburden, and topsoil.

Equipment storage yards incidental to resource management, including parking, repairing and storage of equipment so used.

Accessory structures, offices, or other uses incidental to river terrace operations.

- c. Instream operations: Sand and gravel operations which entail the extraction and sale of sand, gravel,

and overburden; processing shall be limited to the removal and placement of oversized (+3") particles.

2. Geotechnical studies involving grading or construction.
3. Fuel wood management including commercial harvesting and onsite and off-site sales of fuel woods.
4. Cottage industries.
5. Incidental retail sales of agricultural products produced on the premises.
6. Controlled Burns undertaken for purposes of fuel load management and wildlife habitat enhancement.
7. Oil and gas wells.
8. Solid waste disposal sites and land fills.
9. The raising, feeding, maintaining, and breeding of poultry, fowl, rabbits, fur-bearing animals, and the like, for other than domestic purposes.
10. Commercial hog and pig farming.
11. Dairies.
12. Livestock feed yards, veal calf raising.
13. Commercial stables, riding academies and hunting clubs.
14. Commercial aquaculture.
15. Commercial mushroom farming.

16. Wholesale nurseries and greenhouses for the indoor propagation and harvesting of shrubs, plants, flowers, trees, vines, fruits, vegetables and similar crops.

17. Incidental retail sales of agricultural products produced on the premises.

(c) *RESIDENTIAL USES*

1. A second dwelling unit per lot where allowed by the density limitations of a "B" District.
2. Additional single-family dwellings for agricultural employees are permitted subject to the requirements of Section 26-61.

(d) *TRANSPORTATION USES*

1. Private landing strips.

(e) *EDUCATIONAL USES*

1. Agricultural and environmental schools and research facilities which do not adversely affect the primary purpose of the district.

(f) *UTILITIES*

1. Public service and utility uses, telephone equipment buildings, power stations, transformer stations, pumping stations, reservoirs and storage tanks which do not adversely affect the primary purpose of the District.

(g) *INCIDENTAL USES*

1. Accessory structures incidental to

uses other than resource management
(Section 26-52 b).

2. Water conservation dams and ponds.

(h) *SIGNS*

1. Directional signs, additional appurtenant sign area subject to Article 33, Sign Regulations, and Article 42, Design Review.

(d) Mineral extraction and production uses shall also comply with Chapter 26A-1 through 26A-17.

(e) Additional setbacks may be required within a sensitive area, riparian corridor, scenic corridor, area of critical habitat, unique feature, or geothermal resource area designated in the General Plan or a Specific Plan.

Section 26-53. Site Development Standards

Site development shall comply with the standards contained in the Sonoma County Surface Mining and Reclamation Ordinance (Ordinance No. 2394, Chapter 26 of the Sonoma County Code).

Parking Requirements

Parking shall comply with Article 32, Parking Standards.

Maximum Building Height

35 feet for residential structures; 50 feet for other structures. Additional height may be granted subject to the provisions of Article 42, Design Review.

Minimum Lot Size for Creation of New Lots

(a) Front yard required: 10% of the depth of the lot, but not more than 75 feet.

(b) Side yard required: 10% of the width of the lot, but not more than 50 feet.

(c) Rear yard required: 50 feet.

SONOMA COUNTY

COMMUNITY AND ENVIRONMENTAL SERVICES



Duane Butler, Director

PLANNING DIVISION

Pranab Chakrawarti, Deputy

ANNUAL
AGGREGATE INDUSTRY
DATA FORM

Submittal of the information requested herein fulfills the monitoring requirements of the aggregate use portion of the Aggregate Resources Management Plan. The data furnished in this report will be treated in confidence by the Planning Division unless otherwise authorized below. Information will be released in summary form only. Please complete those portions of this form which are applicable to your particular operation. If you mine deposits from more than one extraction area, submit a separate form for each area. If you mine from more than one type of source (i.e., hard rock quarry, instream and alluvial terrace), submit a separate form for each source.

SIGN IF CONFIDENTIALITY WAIVED _____

1. Name of Operation: _____

Address or Location: _____

2. Status During Year (check one)

Active

Idle

Abandoned

Change of Ownership

Shipping from Stockpile only

3. Type of Operation (check one)

Hard Rock Quarry

Instream Dredging or Skimming

Alluvial Terrace Pit

Other (specify): _____

ANNUAL AGGREGATE INDUSTRY DATA FORM - 2

4. Hard Rock Quarry Only:

Stone or crushed and broken stone of your own production sold or used during the year by use and product. Code numbers in first column refer to U. S. Bureau of Mines data form for "Stone".

- A. Dimension Stone: Report type and quantity of any dimension stone produced by your operation in short tons or cubic feet.

Product	Bureau of Mines Code #	Quantity	
		Short tons	Cubic feet
	101-105 and 201-207		

- B. Crushed and Broken Stone: Report quantity in short tons OR in cubic yards.

Use and Product	Code #	Quantity	
		Short tons	Cubic yards
Concrete aggregate	304		
a. Residential			
b. Non-residential			
c. Highways, bridges, roads & streets			
d. Dams			
e. Waterworks			
f. Airports			
g. Other			
Concrete products (cement blocks, bricks, pipe)	304A		
Asphalt concrete aggregate	306		
Aggregate road base	307		
Aggregate road sub-base			
Surface treatment aggregate	308		

continued . . .

ANNUAL AGGREGATE INDUSTRY DATA FORM - 3

B. Crushed and Broken Stone (continued)

Use and Product	Code #	Quantity	
		Short tons	Cubic yards
Other construction aggregate and road-stone (specify)	309		
Riprap and jetty stone	310		
Railroad ballast	311		
Filter stone (drain rock)	312		
Manufactured fine aggregate (stone sand)	313		
<u>Fill</u>			
Other fill purposes			
Trench bedding			
Trench backfill			
Structure backfill			
Other (specify)			
TOTAL CRUSHED AND BROKEN STONE	399		

5. Sand and Gravel *only*

Sand and gravel of your own production sold or used during the year by use and product. Code numbers in first column refer to U. S. Bureau of Mines data form for "Sand and Gravel".

A. Construction Sand and Gravel

(1) Quantity Sold or Used (processed and pit run)

Product	Code	Processed and pit run Quantity (short tons)
Sand (passing #4 mesh)	301	
Gravel (retained #4 mesh)	302	
TOTAL	309	

ANNUAL AGGREGATE INDUSTRY DATA FORM - 4

A. Construction Sand and Gravel (continued)

(2) Use, Quantity Sold or Used (estimate where exact quantities are unknown)

Use and Product	Code #	Quantity (Short tons)
Concrete aggregate	410	
a. Residential		
b. Non-residential		
c. Highways, bridges, roads and streets		
d. Dams		
e. Waterworks		
f. Airports		
g. Other		
Concrete products (cement blocks, bricks, pipe, etc.)	420	
Asphaltic concrete aggregates	430	
Road bases	440	
Road subbases	440a	
<u>Fill</u>	450	
Trench bedding	450a	
Trench backfill	450b	
Structure backfill		
Railroad ballast	460	
Drain rock		
Other uses (specify)	470	

ANNUAL AGGREGATE INDUSTRY DATA FORM - 5

6. Transportation of
☐ Hard rock
☐ Sand and gravel
 (check one)

 to first point of sale or use by method. If quantities are unknown, estimate by percentage the portion or estimate production transported by each method.

Method of transportation	Code #	Quantity (Short tons)
Truck	501	
Railroad	502	
Waterway	503	
Other transportation (specify)	504	
Not transported (used or sold at extraction site)	505	
Total	509	

7. Location of Use (Use map as a guide.)

Estimate the percentage of your total production which goes to each of the following market areas (A-H).

A. NORTHERN SONOMA COUNTY MARKET AREA:

Cloverdale Planning Area (No. 2)

Healdsburg Planning Area (No. 3)

B. WESTERN SONOMA COUNTY MARKET AREA:

Coastal Planning Area (No. 1)

Russian River Planning Area (No. 4)

C. CENTRAL SONOMA COUNTY MARKET AREA:

Santa Rosa Planning Area (No. 5)

Sebastopol Planning Area (No. 6)

Rohnert Park/Cotati Planning Area (No. 7)

D. SOUTHERN SONOMA COUNTY MARKET AREA:

Petaluma Planning Area (No. 8)

Sonoma Planning Area (No. 9)

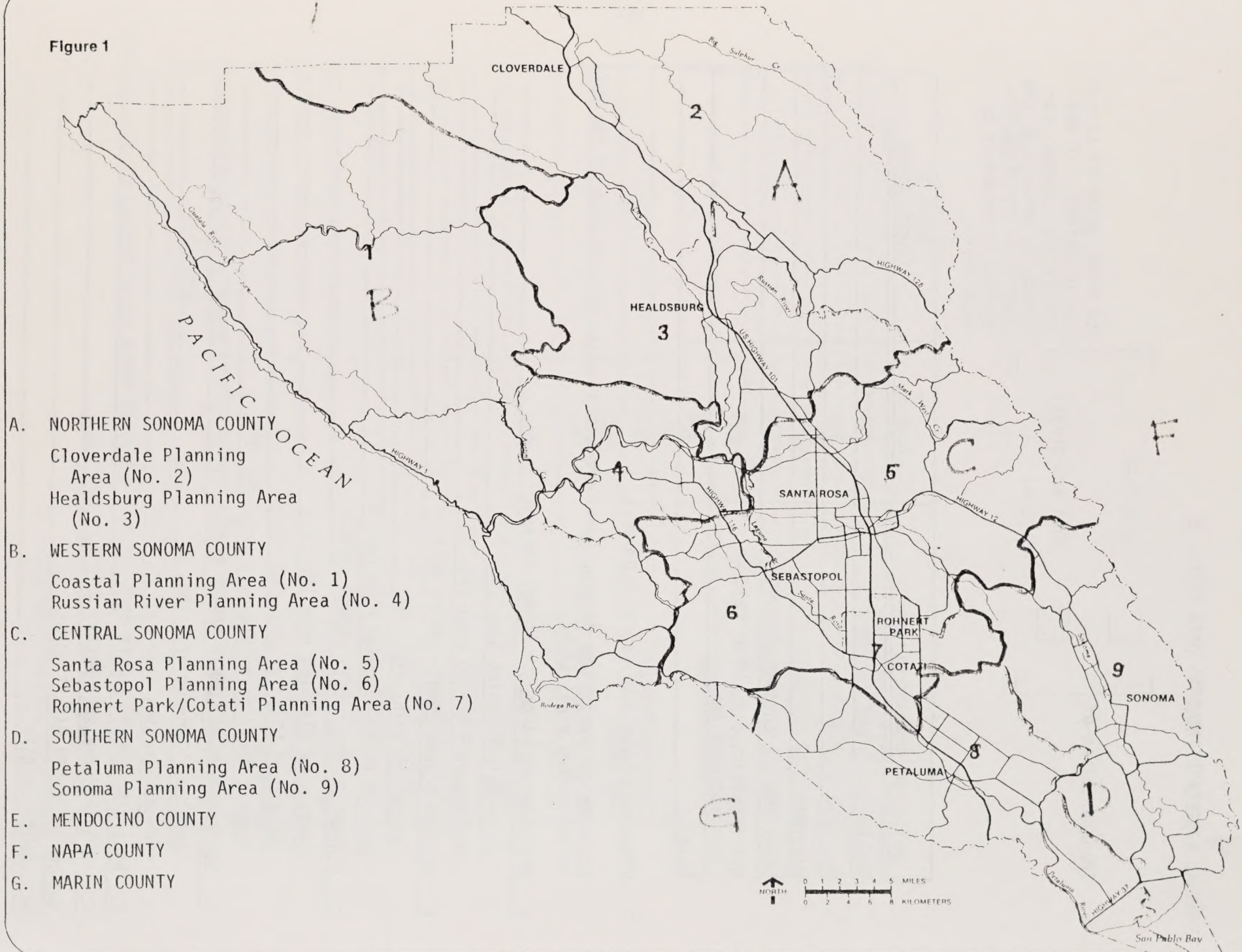
E. MENDOCINO COUNTY MARKET AREA:

F. NAPA COUNTY MARKET AREA:

G. MARIN COUNTY MARKET AREA:

H. OTHER (SPECIFY):

Figure 1



ANNUAL AGGREGATE INDUSTRY DATA FORM - 6

8. Energy Consumption: Use of Fuel and Electricity During the Year

	Quantity	Approximate Cost
Fuel for year	gal.	\$
Fuel per ton-mile	gal.	\$
Electricity for year	k.w.	\$
Electricity per ton	k.w.	\$

9. Imports:

Report the quantity and use of aggregate materials which are imported by your operation into Sonoma County.

10. Remarks and Suggestions:

APPENDIX J

HYDROLOGY MONITORING PROGRAM

AERIAL SURVEY

FLIGHT SPECIFICATIONSMiddle Reach

A. Area to be Covered:

The Russian River (including the channel and associated riparian corridors), beginning on the downstream end at a point one-fourth mile downstream of Wohler Bridge and continuing upstream to the Healdsburg Dam (R.M. #31.8).

B. One aerial survey per year will be accomplished following the recession of winter flows in the river to the point that the live summer channel is well defined. The flight survey will be conducted prior to April 1 of each year and at the time of day when shadows are minimal (10:00 a.m. to 2:00 p.m.).

C. Photography:

To be flown at a scale of 400' to 1" permitting an accuracy of a 2' contour using national map standards for all areas not obscured by vegetation or brush and shadows.

D. Cross Sections:

Perform photogrammetric cross sections to a $\pm 0.5'$ accuracy on a series of 13 stations corresponding to the section locations surveyed by the U. S. Army Corps of Engineers in June, 1972. The extent of each section will run from a point 50 feet outward of the stream-bank to the surface of the water on both banks

at the topographic breaks. The cross sections are to be delineated with spot elevations plotted on a pencil manuscript. No mapping will be necessary.

E. Ground Control:

Ground control can be retrieved from the cross section reference monuments located along the river. Their locations are on file at the San Francisco District Office of the U. S. Army Corps of Engineers (Hydrology and Hydraulics Section).

F. Delivery Items:

1. One copy of a pencil manuscript containing the recorded spot elevations.
2. One set of photographic contact prints (9 x 9 format).
3. One copy of field notes for initial monumentation orientation.
4. One copy of computer tapes.

Alexander Valley and Middle Reach

A. Area to be Covered:

Three separate sections of the Russian River (including the channel and associated riparian corridor) are to be surveyed. One begins at the downstream end at the Healdsburg Dam (R.M. #31.8) and continues upstream to the point just above R.M. #33 where Bailhache Avenue turns away from the river. The second section begins at R.M. #44 below the Sausal Creek confluence and continues uninterrupted upstream to the vicinity of Gill Creek (R.M. #53.8). The third section begins upstream of the Asti Winery (R.M. #58) and continues to the mouth of Big Sulphur Creek (R.M. #62.6).

B. Timing:

Two aerial surveys will be completed each year. The first will coincide with the survey of the Middle Reach following the recession of winter flows to the point that the live summer channel is well defined and no later than April 1 of each year.

The second survey will be accomplished upon completion of extraction operations but, in no case, after November 1 of each year. The surveys will be performed during the period of the day when shadows are minimal (10:00 a.m. to 2:00 p.m.).

C. Photography:

To be flown at a scale of 400' to 1" permitting an accuracy of a 2' contour using national map standards for all areas not obscured by vegetation or brush and shadows.

D. Map and Cross Sections:

Perform photogrammetric cross sections to a $\pm 0.5'$ accuracy on a series of stations at 200' intervals, the extent of each to run from a point 50' outward of the streambank to the surface of the water on both banks at topographic breaks. These cross sections will be delineated by spot elevations plotted on a 200' to 1" (2 x enlargement) scale pencil manuscript of the surveyed area.

E. Ground Control:

Ground control may be retrievable from bridges and other benchmarks in the surveyed area. Local control is also available at reference monuments presently used by the Sonoma County Water Agency in its ongoing survey of the Russian River channel.

F. Delivery Items:

1. One pencil manuscript with plotted spot elevations at a scale of 200' to 1" (2 x enlargement).
2. One set of photographic contact prints.
3. One copy of field notes for initial monument orientation.
4. One copy of computer tapes.

APPENDIX K

ORDINANCE NO. _____

ORDINANCE OF THE BOARD OF SUPERVISORS OF THE COUNTY OF SONOMA
REGULATING SURFACE MINING AND RECLAMATION

The Board of Supervisors of the County of Sonoma, State of California, do ordain as follows:

Chapter 26A of the Sonoma County Code is hereby amended to read as follows:

SECTION 26A-1 PURPOSE, SCOPE AND AUTHORITY

a) PURPOSE. This chapter is adopted pursuant to the provisions of the Surface Mining and Reclamation Act of 1975 (Public Resources Code sections 2710 et seq.). Nothing contained herein is intended to modify or abridge the provisions of that act. The definitions and provisions of the Act and the policy regulations adopted pursuant thereto are incorporated herein and this article shall be interpreted in a manner consistent therewith.

b) INTENT. It is the intent of the Board of Supervisors to protect the quality of the County's environment, to protect against land uses incompatible with preservation and utilization of natural resources, and to assure the community of adequate supply of these resources for present and future generations. It is the further intent of the Board to:

- i) Prevent or mitigate the potential adverse effects on the environment, including air quality, groundwater, water quality, aquatic and wildlife habitat, flooding, soil erosion, sedimentation effects, and excessive noise;
- ii) Assure progressive reclamation concurrent with mining so that mined lands are returned to a condition adaptable for alternate land uses, with no residual hazards to public health or safety and with land and water resources maintained in a state beneficial to society; and
- iii) Assure that all mining be conducted in a manner consistent with the mineral resource management policies of the conservation element of the General Plan.
- iv) Encourage the production and conservation of minerals essential to the continued economic well-being of the County and to the needs of the society.

c) OPERATIONAL STANDARDS. The Board of Supervisors finds that it shall be the responsibility of the County to set standards regarding operational aspects of surface mining operations including, but not limited to (1) hours of operations, (2) noise, (3) dust, (4) fencing, and (5) purely aesthetic considerations, (6) the mitigation of potentially adverse environmental effects.

d) APPLICATION. Provisions of this chapter shall apply to the unincorporated areas of Sonoma County.

SECTION 26A-2 DEFINITIONS

a) Bench Interval: The difference in vertical elevation between any two consecutive benches.

b) Committee: Project Review and Advisory Committee defined in Section 23A-3(e) of this Code.

c) Director: Director of Planning Department.

d) Exploration or Prospecting: Exploration or prospecting is defined as the search for minerals by geological, geophysical, geochemical or other techniques, including, but not limited to, sampling, assaying, drilling, or any surface or underground works needed to determine the type, extent, or quantity of mineral present.

e) Flow Line: The line formed by the boundary between the flowing water and exposed surface gravels in the gross channel.

f) Gross Channel: The entire stream channel below the ordinary high water mark.

g) Hardrock Operation: A surface excavation created for the mining of bedrock geologic deposits, or soil for fill, construction or other purposes together with its processing and shipping.

h) Hearing Officer: Qualified person engaged by the Board of Supervisors to perform specific duties in the review and approval of reclamation plans for surface mining operations, that enjoy vested rights as defined in this chapter.

i) Intermittent Stream: A stream having surface flow during wet periods of the year only.

j) JTU: "Jackson Turbidity Units" are an indexing system used by the Regional Water Quality Control Board relative to turbidity of water.

k) Longitudinal Gradient: The slope of the stream channel bottom as determined by a series of channel thalwegs. The "longitudinal gradient of the gross channel" is determined by the elevations of gravel bars measured at the center line of the gross channel equidistant from each ordinary high water mark.

l) Mine: Mine is defined to include all mineral bearing properties of whatever kind or character, whether underground, or in a quarry or pit, or any other source from which any mineral substance is obtained.

m) Mining: The process or business of taking mineral substances from a pit, quarry or excavation in the earth. Mining does not include grading and excavation in conjunction with other permitted construction activities or development of geothermal resources.

n) Ordinary High Water Mark: The line on the shore established by the fluctuation of water indicated by physical characteristics such as a clear, natural line impressed on the bank; shelving; changes in the character of soil; destruction of terrestrial vegetation; the presence of litter and debris; or other appropriate means that consider the characteristics of the surrounding areas.

o) Overburden: Earth materials which overlie resource deposits and which must be removed prior to resource extraction

p) Oversize Gravels: Any streamworked rock materials not passing a three (3) inch screen.

q) Perennial Stream: A stream having surface flow for the entire year.

r) Reclamation: The combined process of land treatment that minimizes water degradation, air pollution, damage to aquatic or wildlife habitat, flooding, erosion, and other adverse effects from surface mining operations, including adverse surface effects incidental to underground mines, so that mined lands are reclaimed to a usable condition which is readily adaptable for alternate land uses and create no danger to public health and safety. The process may extend to affected lands surrounding mined lands, and may require backfilling, grading, resoiling, revegetation, soil compaction, stabilization or other measures.

s) Riparian Vegetation: Vegetation along rivers, streams, creeks, lakes, or tidewaters characterized by the presence of approximately 20% or more by number of any of the following species of trees:

Cottonwood	Willows
Box elder	White alder
Black walnut	Big-leaf maple
Oregon ash	California buckeye

t) Slope Ratio: The ratio of change in horizontal elevation to the change in vertical elevation expressed as two numbers separated by a colon (e.g., 2:1).

u) Stream Bed Skimming: Excavation of sand and gravel from stream bed deposits above the mean summer water level or stream bottom, whichever is higher.

v) Stream Terrace Pit Operation: A surface mining operation that consists of excavation pits in stream terraces and related activities to recover aggregate rock and sand.

w) Thalweg: The line or thread of a stream that constitutes the lowest or deepest part of the stream channel.

x) Transmissivity: The rate of flow of groundwater through a unit width of an aquifer under a unit hydraulic gradient. Transmissivity is equal to the permeability times the saturated thickness of the aquifer.

y) Transverse Gradient: The slope of the gross channel bottom generally perpendicular to its downstream direction.

SECTION 26A-3 PERMIT AND PLAN REQUIRED

a) Exceptions. Except as specified in Section 26A-3(b), no person shall conduct surface mining operations unless a surface mining permit is obtained and a reclamation plan is approved as provided by Section 26A-4 and the California Surface Mining and Reclamation Act of 1975.

i) General. The provisions of this ordinance are not applicable to:

- 1) Excavations or grading conducted for farming or on-site construction or for the purpose of restoring land following a flood or natural disaster.
- 2) Surface mining operations that are required by federal law in order to protect a mining claim, if such operations are conducted solely for that purpose.
- 3) Such other surface mining operations categorically identified by the State Board pursuant to Sections 2714(d) and 27-58(c) of the Public Resources Code as involving only minor and infrequent surface disturbances, provided the Director has determined that such exemption would be consistent with Section 26A-16 of this chapter.
- 4) Grading or excavation for purposes of protecting life and/or property from flood or other emergency as declared by the Board of Supervisors.

b) Vested Right. No person who has obtained a vested right to conduct surface mining operations prior to January 1, 1976, shall be required to secure a permit to mine as long as such vested right continues; provided that no substantial change is made in that operation except in accordance with the provisions of the Act and this chapter. A person who has obtained a vested right to conduct surface mining operations shall submit to the Director within a period of nine (9) months from the effective date of this Ordinance a reclamation plan for operations conducted after January 1, 1976.

SECTION 26A-4 APPLICATION PROCEDURE: NEW MINING OPERATIONS

a) Requirements. In addition to the requirements of this chapter, all mining shall be subject to the requirements of Chapter 26.

The applicant shall submit his permit application and reclamation plan to the Director. Applications shall be made on forms provided by the County and shall be accompanied by such additional information as the Director requires to fully explain the proposed operation. The mining permit proposal and reclamation plan shall conform to the requirements of Sections 26A-6 and 26A-7 of this Code.

b) Director Review. The Director, or his designee, shall review the application within thirty (30) working days and determine if it contains adequate information to proceed to the Committee. The Director shall return the permit application to the applicant for additional information or clarification if, in his opinion, it is incomplete for the proposed project.

c) Committee Review. The Committee shall review the mining permit application and reclamation plan and shall recommend conditions and monitoring procedures to the Planning Commission.

d) Public Hearing. The Planning Commission shall conduct a public hearing on the mining permit and reclamation plan. The Commission may continue the hearing from time to time.

e) Notice. At least ten (10) working days' notice of all hearings shall be given by the Director through the United States mails with postage prepaid to all persons shown on the last equalized assessment roll as assessees of parcels of real property within 300 feet of the parcel to be affected, and by publication in a newspaper of general circulation within the County. Said notice shall include a general explanation of the matter to be considered, including a general description of the area to be affected.

f) Approval. The Planning Commission shall approve, approve with conditions, or reject the reclamation plan. The Planning Commission may approve, approve with conditions, or reject the mining permit. A mining permit shall not be approved without prior approval of its reclamation plan.

g) Issuance. A mining permit . . .

i). . .for hardrock operations shall be granted for a period not to exceed twenty (20) years, at the end of which time it shall expire. Upon written request to the County, before expiration of said permit, said permit shall be reissued for periods not to exceed twenty (20) years if the permittee can establish to the satisfaction of the Planning Commission, or on appeal to the Board of Supervisors, that the use has not been conducted in a manner:

1) detrimental to the environment beyond impacts anticipated at the time of permit approval,

or

2) in violation of permit conditions.

An application for reissuance shall be processed in the manner provided in Section 26A-3.

ii). . .for terrace operations shall be granted for a period not to exceed three (3) years, at the end of which time it shall expire.

iii). . .for instream operations shall be granted for a period not to exceed five (5) years, at the end of which time it shall expire. Upon written request to the County, before expiration of said permit, said permit shall be reissued for periods not to exceed five (5)

years if the permittee can establish to the satisfaction of the Planning Commission, or on an appeal to the Board of Supervisors, that the use has not been conducted in a manner: 1) detrimental to the environment beyond impacts anticipated at the time of permit approval, or 2) in violation of permit conditions. An application for reissuance shall be processed in the manner provided in Section 26A-3.

In addition, permits for instream operations shall be subject to annual adjustment of the amount of materials which can be removed from the mining site as determined by the Director on the basis of data obtained through the monitoring program established by the Aggregate Resources Management Plan.

SECTION 26A-5 APPLICATION PROCEDURE: ESTABLISHMENT OF VESTED RIGHT AND APPROVAL OF RECLAMATION PLAN

a) Vested Right, Defined. A person shall be deemed to have vested rights if, prior to January 1, 1976, he has, in good faith and in reliance upon a permit or other legal authorization, if such permit or other authorization was required, diligently commenced surface operations and incurred substantial liabilities for work and materials necessary therefor. Expenses incurred in obtaining the enactment of an ordinance in relation to a particular operation or the issuance of a permit shall not be deemed liabilities for work or materials.

b) Vested Right Statement. The Director shall undertake to provide reasonable notice to all mining operators of the requirements of this chapter; provided, however, that his failure to do so shall not exempt any operator from the requirements of this chapter.

i) A completed "Statement of Vested Right" form provided by the County. A claim of vested right shall not be recognized if submission of the Statement of Vested Right and affidavit is not made within ninety (90) days of the effective date of this chapter.

ii) An attached affidavit or declaration certifying that the information furnished is true and accurate.

c) Director Hearing. The Director may hold a hearing on the claim for vested right if he finds insufficient factual information to establish the extent of intensity of the vested right. The hearing shall be noticed in the same manner provided for in Section 26A-4(e). The Director shall have the authority to adopt rules governing the procedure for the hearings, including the authority to require all evidence to be presented in the form of declarations.

d) Reclamation Plan. A reclamation plan for an operation with a vested right shall be filed with the Director prior to October 1, 1980. The reclamation plan shall provide for the reclamation of the area disturbed by surface mining operations mined after January 1, 1976. No substantial changes shall be made in the operation during the period in which the reclamation plan is being considered for approval. The reclamation plan shall conform to the requirements and form of Section 26A-7.

e) Director Review. The Director, or his designee, shall review the reclamation plan within thirty (30) working days and determine if it contains adequate information to proceed to the Committee. The Director shall return the reclamation plan to the applicant for additional information or clarification if, in his opinion, it is incomplete.

f) Committee Review. The Committee shall review the reclamation plan and shall recommend conditions, modifications and monitoring procedures to the Hearing Officer.

g) Public Hearing. The Hearing Officer shall hold a public hearing on the reclamation plan. The hearing shall be noticed in accordance with Section 26A-4 (f). The Hearing Officer may adopt rules governing the hearing procedure and may continue the hearing as necessary.

h) Action. The Hearing Officer shall approve, approve with conditions, or reject the reclamation plan within twelve (12) months of the date of submission. In the event the Hearing Officer rejects the reclamation plan, he shall state the reasons for that rejection in writing.

i) Compliance. The Hearing Officer shall reject the reclamation plan if it does not comply with all of the requirements listed in Section 26A-7, and Section 26A-8.

j) Extension. Should approval of the reclamation plan not be obtained within twelve (12) months after the effective date of this Ordinance, all of the subject surface mining operations shall be terminated and those areas mined after January 1, 1976, shall be reclaimed in a manner generally in conformance with Section 26A-7(b), and subject to the approval of the Director. The Director may grant reasonable extensions of time for obtaining approval of the reclamation plan if approval is being diligently pursued by the applicant and if more time is required to fulfill all of the requirements and complete all of the procedures for such approval.

SECTION 26A-6 MINING PERMIT STANDARDS

a) Operational Standards. In addition to meeting the minimum acceptable surface mining and reclamation practices in the Act and policy guidelines, each surface mining operation requiring a permit shall be conducted and designed to meet the following operational standards. Conditions may be imposed on mining permits to ensure compliance with minimum acceptable practices and standards.

b) Off-Street Parking. Adequate off-street parking shall be provided to accommodate the expected use from employees, customers and equipment, subject to Section 26-177(1) of this Code.

c) Roads and Driveways.

i) Access Roads - All private access approaches leading off any paved public street onto a mining site shall be adequately surfaced to prevent aggregate or other materials being drawn onto the public right-of-way.

- ii) Dust Suppression - All haul roads and driveways shall be maintained as necessary to minimize the emission of dust. Maintenance shall be conducted as necessary to prevent a nuisance to adjacent properties. Special maintenance procedures (watering, oiling, etc.) may be placed on the permit.
- iii) Driveway Encroachment Permit - If required, a driveway encroachment permit issued by the Sonoma County Department of Public Works shall be obtained by the applicant prior to approval of the mining permit.
- iv) Traffic Signs and Traffic Management Facilities - Traffic warning signs, bicycle lanes, acceleration-deceleration lanes, turning lanes or other traffic management facilities shall be placed by the Operator at appropriate locations as determined by either the State Department of Transportation or the Sonoma County Department of Public Works.
- v) Public Road Maintenance - Where public roads are used to access the mining site, provisions may be required in the mining and/or reclamation plan for the upgrading of such roads to a standard capable of accommodating the additional weight of vehicles. Such provisions, if required, shall meet the approval of either the State Department of Transportation or the Sonoma County Department of Public Works.

d) Runoff, Flood Control and Water Quality. All excavation operations shall be conducted in such a manner as to minimize: (a) ponding or accumulation of storm water not necessary for silt control, (b) alterations to the natural drainage system, and (c) siltation of adjacent or downstream watercourses.

- i) Applicants are advised that any of the drainage alterations, ponding or filling activities listed below must be approved by the Sonoma County Water Agency before commencing operations. Activities included are those which . . .
 - 1) Impair or impede or obstruct the natural flow of storm waters, or other water running in a defined channel, natural or man-made, or cause or permit the obstruction of any such channel.
 - 2) Deposit any material in such channel.
 - 3) Alter the surface of land so as to reduce the capacity of such channel.
 - 4) Construct, alter, or repair any storm water drainage structure, facility or channel without first obtaining a permit therefor, as herein provided.
 - 5) Commit any act, within any easement dedicated for drainage purposes, that will impair the use of such easement for such purpose.

- 6) Place any material along the sides of any defined channel or so close to the side of said channel as to cause such material to be carried away by flood waters passing through such channel.
- 7) Construct any structure within 100 feet of the top of any embankment, natural or man-made which defines a channel, except structures constructed on a lot in a subdivision where the flood hazard has been found to be remote in the review of the Sonoma County Water Agency.
- 8) Deposit any material as aforesaid, which contains paper, bottles, cans, lumber, garbage, organic matter, or other material which will not readily become an integral part of said channel side.
- 9) Deposit car bodies or any unsightly material on the top or sides of any embankment, natural or man-made which defines a channel.

Dams constructed for the purpose of impounding water when designed or approved by an agency of the Federal Government or of the State of California, or when subject to review and approval by the State of California, Department of Water Resources, pursuant to Part 1 of Division 3 of the California Water Code, shall be exempt from the above provisions.

- ii) Any waters discharged from the site to adjacent lands, streams, or bodies of water or to any groundwater body shall meet all applicable water quality standards of the Regional Water Quality Control Board and any other agency with authority over such discharges. Records of any water quality monitoring conducted in conjunction with the requirements of such agency or agencies shall be made available to the Director on request. Discharges of water to designated on-site settling ponds or desilting basins shall not be deemed to be in violation of this part solely on the basis of sediment content.
- iii) Excavations which may penetrate near or into usable water bearing stratas shall not subject such groundwater basin or subbasin to pollution or contamination.
- iv) Erosion and Sedimentation
 - 1) During the period mining operations are being conducted, and prior to final reclamation of mined lands, measures shall be taken to prevent erosion of adjacent lands from waters discharged from the site of mining operations or the offsite discharge of sediment. Such measures may include the construction of properly designed retarding basins, settling ponds and other water treatment facilities, ditches, diking and revegetation of slopes. Settling ponds and other water treatment facilities shall be located and managed so that accumulated sediment will not enter any stream or groundwater body

unless such discharge is in accordance with an approved reclamation plan.

- 2) Sediment basins, settling ponds, ditches, levees, dikes, culverts and other structures as well as erosion control and streambank protection measures shall be in accordance with recommendations and standards presented in

aa) "Erosion and Sediment Control Handbook"

Perry Y. Amimoto
California Division of Mines and Geology
State Department of Conservation, 1978

and

bb) "Flood Control Design Criteria"

Sonoma County Water Agency
Revised Edition, 1973.

- 3) Grades in areas being mined shall be maintained so as to avoid accumulations of water that could serve as breeding areas for mosquitoes or as sites of fish entrapment.

e) Operation Information. All operators of mining operations requiring mining permits and/or reclamation plan approvals shall annually supply, subject to Section 26A-16, operation information included on the "Annual Aggregate Industry Data Form", a copy of which is to be provided by the Director. The data form is to be submitted no later than March 1 of each year.

- i) Instream and terrace operations, in addition to the requirements of Section 26A-6e, shall provide to the County biannual topographic mapping of, and profiles through, the stream channels as specified by the Director and the Aggregate Resources Management Plan.
- ii) Hardrock operations, in addition to the requirements of Section 26A-6e, shall provide to the County topographic mapping or a description of the topographic change resulting from the operation. This information shall be submitted no later than March 1 of every other year beginning with the approval of the reclamation plan.

f) Noise Control.

- i) Noise levels created by the operation as measured at the nearest boundary of the mineral resource district shall not exceed the following:
 - 1) 65 dB(A) for a cumulative period more than 30 minutes in any hour;
 - 2) 70 dB(A) for a cumulative period more than 12 minutes in any hour;
 - 3) 75 dB(A) for a cumulative period more than 3 minutes in any hour;

- 4) 80 dB(A) for a cumulative period more than 1 minute in any hour;
- 5) 85 dB(A) at any moment.
- 6) More stringent noise standards may be required as permit conditions when particular local circumstances warrant additional protection of potentially affected areas.
- ii) Any noise control measures prescribed by the Commission as a condition of a permit shall in no manner be interpreted as to preclude the application to the surface mining site of future noise control measures adopted by the County subsequent to the grant of the permit.

g) Hours of Operation. Unless otherwise provided by condition of the permit, the permit granted hereunder shall authorize operations of mining, processing, and related activities as follows:

- i) Monday through Friday:
6:00 a.m. through 10:30 p.m.
- ii) Saturday:
6:00 a.m. until 4:30 p.m.
- iii) Sundays and National Holidays:
No mining or processing unless authorized as a condition of the permit.
- iv) Exceptions to these time limitations may be authorized by the Director upon written request of the operator in conjunction with special contracts which require unusual hours of operation.
- v) In the event of emergencies involving catastrophe, or threat to public safety or property, these time limitations shall not apply.
- vi) These time limitations shall not apply to the normal activities relating to maintenance of stationary or mobile equipment and delivery of supplies.

h) Fencing, Posting and Security. The applicant shall show on the plans the location of all fences, signs warning of the mining operation, and other site hazard protection equipment necessary to provide adequate public protection. Additional hazard protection may be required by the Director. Gates, lighting, site patrol or other measures may also be required by the Director in order to ensure the security of the mining site and any private access routes thereto. Fencing height, type, and location and the standards for other hazard protection equipment shall also be subject to the approval of the Director.

j) Sight Regulations. Provisions shall be made where practical for buffering, berming, and visual screening between the operation and an adjacent public street right-of-way, public uses such as schools, parks, golf courses and other such public uses determined to be visually sensitive by the County. Special provisions for screening may be required for operations in designated scenic areas or within three hundred (300) feet of a designated scenic corridor. The height and type of such screening shall be set by the permit.

k) Slopes and Benches.

- i) Finished slopes shall conform to the requirements of Section 26A-7(b)ii.
- ii) Temporary slopes steeper than the finished slopes, in areas where finished slopes are to occur, shall be constructed and maintained in accordance with the recommendations, as approved by the Director, of a soil engineer or a civil engineer registered in the State of California or an engineering geologist registered and certified in the State of California. Temporary slopes shall not be created or maintained in a manner that will interfere with the construction of finished slopes conforming to part (i) of this subsection, and the soil engineer or engineering geologist shall make specific recommendations for the conversion of such temporary slopes to finished slopes.
- iii) Benches shall be provided on any working slope with a vertical elevation in excess of forty (40) feet unless otherwise recommended, as approved by the Director, by a soil engineer or civil engineer registered in the State of California or an engineering geologist registered and certified in the State of California. The bench interval shall not exceed thirty (30) feet in vertical distance. Benched slopes shall not be created or maintained in a manner which will interfere with the construction of final reclaimed slopes according to Section 26A-7(b)ii.

l) Setbacks. Minimum setbacks between the mined area and the nearest boundary of the Mineral Resource District or individual sewage disposal system shall be as follows:

- i) The applicant may be required to submit to the County a detailed geological investigation prepared by a registered engineering geologist addressing the suitability of excavating the proposed site, taking into consideration maintaining the integrity of adjacent properties and their improvements.
- ii) In the event that there are individual sewage disposal systems near or within the mining site, the mining setbacks shall conform to all provisions of the Sonoma County Code pertaining to sanitary sewage systems and all rules and regulations adopted pursuant thereto, and shall be subject to approval of the Sonoma County Environmental Health Agency and the Regional Water Quality Control Board.

- iii) Periphery of the mining site - A twenty-five (25) foot minimum setback from the Mineral Resource District boundary, consisting entirely of unexcavated land.
- iv) Mining sites adjoining public streets - A twenty-five (25) foot minimum setback from the public street, consisting entirely of unexcavated land.
- v) In addition to the requirements of Section 26A-6(1)iii and iv, a two hundred (200) foot minimum setback from the nearest boundary of the Mineral Resource District for any processing operation such as crushing, screening, washing, classifying or batching when adjacent lands are designated as "managed resource" or "undeveloped" on the General Plan Resources and Undeveloped Areas Map. Extraction operations such as blasting, loading, dredging, ripping, or dozing are permitted within the setback area subject to the requirements of Section 26A-6 (f), (j), (k), (l), (m), and (o).
- vi) In addition to the requirements of Section 26A-6 (1) iii and iv, a four hundred (400) foot minimum setback from the nearest boundary of the Mineral Resource District for any processing operation such as crushing, screening, washing, classifying, or batching when adjacent lands are designated as "development areas", "natural areas", or "parks" on the General Plan Resources and Undeveloped Areas Map. Extraction operations such as blasting, loading, skimming, dredging, dozing, and ripping are permitted within this setback area subject to the requirements of Section 26A-6 (f), (j), (k), (l), (m), and (o).
- vii) A two hundred (200) foot minimum setback consisting entirely of undisturbed land from the bank of any perennial stream.
- viii) A one hundred (100) foot minimum setback consisting entirely of undisturbed land from the bank of any intermittent stream or creek.
- ix) A twenty-five (25) foot minimum setback from any sensitive area, critical habitat, or unique biotic area designated by the General Plan Critical Open Space Map unless such area is subject to vii and viii above.

m) Use of Explosives. No explosives shall be used except as authorized by the surface mining permit. When authorized, the specific times of use shall be approved by the Director and notice of such use will be provided to the Director at least fourteen (14) days prior to the use of any explosives. In addition, blasting operations shall be subject to the requirements of Section 26A-6 (f) and (g).

n) Salvage of Topsoil. Topsoil suitable for use in revegetation shall be stockpiled at the site of mining operations in an amount up to that necessary for future reclamation.

o) Air Quality. All operations and equipment used in the extraction, processing, or transportation of aggregate materials shall be in compliance with the regulations of the applicable Air Pollution Control District. Fugitive dust emissions shall be no greater than one hundred micrograms per cubic meter (100 ug/m³) when measured by the high volume sampling method over a twenty-four (24) hour period at any boundary of the Mineral Resource District.

p) Hardrock Operations.

- i) Archaeological reconnaissance - Whenever there is reason to suspect significant archaeological or paleontological sites (as noted in the Initial Study Process under the California Environmental Quality Act) within the area proposed for operations, an appropriate survey by qualified professionals shall be required. Suggested mitigation measures resulting from such survey shall be implemented prior to the commencement of grading operations.
- ii) Aquifer recharge - No extraction or processing shall take place on any lands where the rate of infiltration of water into groundwater aquifers is equal to or greater than 0.7 acre feet per day according to the California Department of Water Resources.

q) Agricultural Soils. Unless otherwise determined by the Board of Supervisors, no mining operations shall occur on any soil suitable for intensive crop production which have a Class I, II, III, or IV rating according to the U. S. Department of Agriculture or a Storie Index rating of at least forty (40).

r) Instream Operations. Where excavation is to occur between the banks of a stream, the following standards shall also apply:

- i) Processing operations, including crushing, washing, classifying, batching, and screening, other than that necessary for the separation of oversize gravels, shall not be conducted within two hundred (200) feet of the bank or channel of any perennial or intermittent stream.
- ii) Equipment shall not be operated in water except as may be necessary to construct stream crossings subject to the requirements of Section 26A-6 (r)x.
- iii) Unless in accordance with an approved reclamation plan, extraction operations shall not penetrate below the grade established by a line from a point on the surface of the bar along the ordinary high water mark of the channel to the nearest point on the flow line of the live stream. If no flowing water is present, the streamward depth of extraction shall be determined by the point on the surface of the bar that is one (1) foot above the thalweg elevation of the channel. Under no circumstances will the transverse gradient be less than 2 vertical to 100 horizontal.

- iv) The permitted depth of extraction may be further reduced whenever the longitudinal gradient of the cross channel bed established by the height of successive bars above the flowing stream would be significantly altered. The longitudinal gradient of the gross channel shall be determined by bars adjacent to the proposed mining site, including at least one bar upstream and one bar downstream.
- v) No extraction shall be permitted within fifteen (15) feet of the ordinary high water mark of the channel. Setbacks from the ordinary high water mark may be increased when extraction is proposed within eighteen hundred (1800) feet of the mouth of any tributary stream.
- vi) Quantities of raw materials to be extracted from each mining site are also subject to the requirements of Section 26A-4(g).
- vii) Separated oversize gravels used for bank armoring shall be placed in a location at or near the ordinary high water mark of the channel in a manner to be specified by the Director.
- viii) Disturbance or removal of vegetation above the ordinary high water mark shall not exceed the minimum necessary to provide access to the mining site along a road no wider than fifteen (15) feet.
- ix) Under no circumstances shall extraction operations take place prior to May 1 or after October 15 of each year.
- x) Instream crossings - The placement and removal of any stream crossings shall be in compliance with the requirements of the Regional Water Quality Control Board and the State Department of Fish and Game and
 - 1) shall not result in the roiling of water in excess of the requirements of Sonoma County Ordinance 339;
 - 2) shall not increase the turbidity of the waters of the Russian River or its tributaries by more than the following:

Within the area of immediate influence (*).

<u>Background Turbidity Upstream of the Operation</u>	<u>Allowable Increase</u>
0 - 30 JTU	5 JTU
Greater than 30 JTU	10 JTU

Outside the area of immediate influence (*) there shall be no increase above background turbidity.

*The area of immediate influence is the area between the point of discharge and a point 500 feet downstream from the discharge.

- 3) shall be such that water flow is not impaired and upstream or downstream passage of fish is assured at all times. Bottoms of temporary culverts shall be placed at or below stream channel grade. Culverts used for this purpose shall have no openings smaller than three (3) feet in diameter.
- 4) shall only be built from material such as clean gravel which will cause little or no siltation as in (1).
- 5) shall not be placed before June 1 or removed later than October 1 of each year.
- 6) the Director shall be notified at least seven (7) days prior to commencement of the placement or removal of instream crossings.

s) Intermittent Operation. Whenever surface mining operations are conducted on an intermittent basis, with one (1) or more years between operating periods, the following procedures shall be followed:

- i) Closing down. The operator shall notify the Director of his intention to close down operations at least thirty (30) days prior to such action. The Director shall inspect the site, notify the operator of what protective devices or structures and what corrective measures are or may be necessary for the protection of adjacent properties, environmental resources and the general public and take appropriate steps to see that necessary corrections are made.
- ii) Starting up. At least thirty (30) days before starting up inoperative mining operations, the operator shall notify the Director who shall inspect the site. Operations shall not recommence until the Director has determined that all requirements of the operation's surface mining permit are met and has authorized such commencement.

The Director shall determine if said requirements have been met within the 30-day period.

SECTION 26A-7 RECLAMATION PLAN STANDARDS

a) RECLAMATION PLAN FORM. All reclamation plans shall be filed on a form provided by the County, and shall contain the following:

- i) The name and address of the operator and the names and addresses of any persons designated by him as his agents for the service of process.
- ii) The anticipated quantity and type of minerals for which the surface mining operation is to be conducted.
- iii) The proposed dates for the initiation and termination of such operation.

- iv) The maximum anticipated depth of the surface mining operation.
- v) The size and legal description of the lands that will be affected by such operation, a map that includes the boundaries and topographic details of such lands, a description of the general geology of the area, a detailed description of the geology of the area in which surface mining is to be conducted, the location of all streams, roads, railroads and utility facilities within, or adjacent to, such lands, the location of all proposed access roads to be constructed in conducting such operation, and the names and addresses of the owners of all surface and mineral interests of such lands.
- vi) A description of and plan for the type of surface mining to be employed and a time schedule that will provide for the completion of surface mining on each segment of the mined lands so that reclamation can be initiated at the earliest possible time on those portions of the mined lands that will not be subject to further disturbance by the surface mining operation.
- vii) A description of the proposed use or potential uses of the land after reclamation and evidence that all owners of a possessory interest in the land have been notified of the proposed use or potential uses.
- viii) A description of the manner in which reclamation, adequate for the proposed use or potential uses will be accomplished, including:
 - (1) a description of the manner in which contaminants will be controlled, and mining waste will be disposed; and (2) a description of the manner in which affected streambed channels and streambanks will be protected and/or rehabilitated to a condition minimizing erosion and sedimentation.
- ix) An assessment of the effect of implementation of the reclamation plan on future mining in the area.
- x) A statement that the person submitting the plan accepts responsibility for reclaiming the mined lands in accordance with the reclamation plan.
- xi) Any other information which the Committee Director, Planning Commission, Hearing Officer or Board of Supervisors may require.

b) RECLAMATION PLAN STANDARDS. Properties used for surface mining operations shall be reclaimed after the operation, or an approved phase of the operation, has been completed in accordance with the following standards:

- i) Time Limitation. Reclamation shall in all cases be completed within the time schedule set forth in the approved reclamation plan. In all cases reclamation shall commence not later than

twelve (12) months following termination of the excavation operation or approved phase. However, the operator is required to proceed as soon as practicable and may be required to progressively rehabilitate the site as the excavation operation or approved phase is completed.

- ii) Final Reclaimed Slopes. Final reclaimed slopes, abandoned spoil piles, topsoil or overburden stockpiles, and the entire mining site shall be graded and smoothed as necessary so as to control erosion, prevent the creation of potentially dangerous areas and present a natural appearance.

1) Hardrock Operations:

The grades of final reclaimed slopes shall be no steeper than 1-1/2 horizontal to 1 vertical unless a steeper angle of repose is recommended as safe and self-supporting by a registered civil engineer qualified in the field of soils engineering and soil mechanics. Fill slopes flatter than 1-1/2:1 will generally be acceptable. When benched slopes are proposed, the entire slope shall be no steeper than 1-1/2 horizontal to 1 vertical from the top of the cut to the base of the slope and no bench shall be greater in width than one-half of the bench interval.

2) Terrace Operations:

- aa) Pit slopes below the minimum water level shall be no steeper than 1 horizontal to 1 vertical.
- bb) Pit slopes above the minimum water level shall be no steeper than 2 horizontal to 1 vertical and shall be so graded no later than November 1 of each year in areas where no further disturbance of the slopes is necessary.
- cc) Dikes, levees, ditches, sediment basins, or other earth structures shall be graded such that side slopes are no steeper than 2 horizontal to 1 vertical.

3) Instream Operations: Final reclaimed slopes in any stream channel shall be graded such that

- aa) The transverse gradient, or slope, is that which is established by a line beginning at a point on the surface of the bar along the ordinary high water mark and ending at the nearest point along the flow line of the stream. If no flowing water is present, the streamward end of the grade shall be determined by the point on the surface of the bar that is one (1) foot above the channel thalweg. The minimum slope in any case shall be 100 horizontal to 2 vertical.

- bb) In areas where the longitudinal gradient of the gross channel bed, established by the height of successive bars above the flow line, would differ significantly from the slope of the channel thalweg elevations, the final reclaimed slope will be determined by the Director.
- iii) Resoiling. Resoiling shall be accomplished in the following manner: coarse, hard material shall be graded and covered with a layer of finer material or weathered waste and a soil layer then placed on this prepared surface where practical. Where quantities of salvaged topsoil are inadequate to provide cover, native materials shall be upgraded to the extent feasible for this purpose.
- iv) Revegetation. All permanently exposed lands that have been denuded by mining operations shall be revegetated unless any such revegetation is determined by the Hearing Officer or the Planning Commission to be technically infeasible or not beneficial with respect to the intent of this section. Revegetation methods shall be appropriate for the topographical, soil, and climatic conditions present at the site and shall conform to the recommendations of the "Erosion and Sediment Control Handbook" by Perry Y. Amimoto, California Division of Mines and Geology, State Department of Conservation.

1) Hardrock Operations:

In addition to the requirements of iv, plant materials utilized for the revegetation of lands denuded by hard-rock operations shall be species native to the biotic community within which the operation occurs. The species list for each community is to be determined by reference to "The Biotic Communities of Sonoma County", Dennis, Northen, Bridges, Kingsley, et al., on file at the Planning Division.

2) Terrace and Instream Operations:

The natural regrowth of riparian vegetation shall generally be encouraged. When it is necessary to revegetate denuded areas, planting shall conform to the requirements of iv, and plant species utilized for revegetation in or near riparian communities shall be selected from the appropriate list of plants identified in "Aggregate Resources Management Plan" master environmental assessment and "The Biotic Communities of Sonoma County". Ripped areas shall be planted with white alder.

- v) Instream Operations. Where mining will occur between the banks of a watercourse,
 - 1) Streambanks affected by the operation shall be rehabilitated according to the standards in "Erosion and Sediment Control Handbook" and "Riparian Woodland, Analysis and Management Recommendations", Aker, et al., T.R.E.E. Project, on file at Planning Division.
 - 2) The streambed above the flow line shall be graded in accordance with Section 26A-7(b) ii 3) and in such a manner that no pools or depressions exist where fish entrapment might occur. Grading operations shall be completed at the conclusion of each year's extraction and no later than November 1 of each year.
 - 3) Oversize gravels separated during the extraction operation shall be placed in a location at or near the ordinary high water mark of the channel in a manner to be specified by the Director. Particular attention shall be given to areas where access routes traverse the ordinary high water mark.
 - 4) At the permanent conclusion of mining operations, any part of the access route within two hundred (200) feet of the streambank shall be regraded and replanted in accordance with the requirements of Section 26A-7(b) iv 2) and v 1).
 - 5) Extraction, grading, screening and placement of oversize gravels and all other activities associated with instream mining operations shall be concluded and equipment removed from the mining site no later than November 1 of each year. Stream crossings used in mining operations shall be removed no later than October 1 of each year.
 - 6) Where processing operations other than the screening of oversize gravels take place within two hundred (200) feet of the banks of any navigable stream as defined by the U. S. Army Corps of Engineers, provisions shall be made in the reclamation plan for visual screening between such operations and the stream channel.
- vi) Grading, Backfilling and Cleanup. Reclamation plans shall make provisions to ensure that the mining site is left in a final condition after operations are complete, that is:
 - 1) safe with stable waste piles, cut slopes, fill slopes and with the elimination of steep-sided pits and holes;
 - 2) free of derelict machinery, waste materials, mining waste and scrap;

- 3) revegetated where necessary for soil stabilization;
- 4) free of drainage problems;
- 5) no toxic substance shall be used as fill material; and
- 6) coordinated with present and potential future land use, topography and the general environment of surrounding property;
- 7) the person responsible for reclamation shall practice effective mosquito control measures;
- 8) access routes not intended for public use in the reclamation plan shall be secured so that adjacent property owners are not unnecessarily subjected to trespass or vandalism.

vii) Drainage, Erosion and Sediment Control.

- 1) Regrading and revegetation shall be designed and carried out to minimize erosion, provide for drainage to natural outlets or interior basins designed for water storage, and to eliminate potholes and similar catchments that could serve as breeding areas for mosquitoes, sites of fish entrapment, or threats to public safety.
- 2) Silt basins which will store water during periods of surface runoff shall be equipped with sediment control and removal facilities and protected spillways designed to minimize erosion when such basins have outlet to lower ground.
- 3) Sediments accumulated in any detention basin, pond, or other facility shall be periodically removed during the operation. Such removal shall take place at least once within fourteen (14) days of and no later than November 1 of each year.
- 4) Final grading and drainage shall be designed in a manner to prevent discharge of sediment above natural levels existent prior to mining operations.
- 5) Upon reclamation, no condition shall remain which will or could lead to the degradation of water quality below applicable standards of the Regional Water Quality Control Board or any other agency with authority over water quality.
- 6) Measures undertaken for slope protection, erosion and sediment control, in addition to meeting the requirements of Section 26A-7(b) ii, iii, and iv, shall conform to the recommendations and standards of "Erosion and Sediment Control Handbook".

- 7) Overburden, waste mud, silt, and other sediments generated by the mining operation shall be stored on site in such a manner that allows their recovery for use in reclamation.
- 8) Levees and other bank protection measures shall conform to the standards of "Erosion and Sediment Control Handbook" and "Flood Control Design Criteria" of the Sonoma County Water Agency. Plans for the maintenance of such measures or structures shall be included in the reclamation plan.

SECTION 26A-8 PERFORMANCE BONDS

a) BOND. All surface mining permits and reclamation plans shall require that the person responsible for reclaiming the mined lands furnish a performance bond, payable to the Board of Supervisors of Sonoma County, to insure timely and proper reclamation of mined areas. The performance bonds shall be coordinated with the reclamation plan and shall be in an amount sufficient to cover the estimated future costs of reclaiming and, if applicable, maintaining each newly commencing stage of the reclamation plan. The Director is authorized to release the bond or security on completion of each stage of the reclamation plan, or upon cessation of operations and after satisfactory reclamation of all excavated areas pursuant to the approved reclamation plans. The bond shall be in a form and amount to be approved by the Director. Generally, the following will satisfy the bond requirement:

- i) Certificates of deposit payable to the County, issued by banks doing business in the State, and insured by the Federal Deposit Insurance Corporation.
- ii) Investment certificates or share accounts assigned to the County and issued by savings and loan associations doing business in the State and insured by the Federal Savings and Loan Insurance Corporation.
- iii) Bearer bonds issued by the United States Government or by the State.
- iv) Cash deposits with the County.
- v) Surety bonds issued by a corporation duly and legally licensed to transact business in the State of California.

SECTION 26A-9 APPEALS

a) APPEAL. The Board of Supervisors or any person aggrieved by an act or determination of the Director, Hearing Officer, or of the Planning Commission in the exercise of the authority granted herein, shall have the right to appeal to the Board of Supervisors. Any appeal must be filed in writing with the Clerk of the Board of Supervisors within thirty (30) calendar days after the action or decision.

- i) Within twelve (12) calendar days after the Clerk receives such a request, the Board of Supervisors shall set and commence a public hearing. The appeal shall be heard de novo. The Clerk of the Board shall give notice pursuant to Section 26A-4(e).
- ii) The public hearing may be continued from time to time. The Board Supervisors may further condition, amend or deny the permit or reclamation plan, provided that said Board action is substantiated by written findings.

SECTION 26A-10 APPEAL TO STATE BOARD

a) APPEAL TO STATE BOARD. An applicant whose request for a permit to conduct surface mining operations in an area of statewide or regional significance, as defined in the State Mining and Reclamation Act, has been denied by County action, or any person who is aggrieved by the granting of a permit to conduct surface mining operations in an area of statewide or regional significance, may within fifteen (15) calendar days of exhausting his rights to appeal in accordance with the procedures of this County, appeal to the State Board. If the State Board determines the decisions of the County are not supported by substantial evidence in the light of the whole record, the Board of Supervisors shall schedule and hold a public hearing to reconsider its action.

SECTION 26A-11 AMENDMENTS

a) AMENDMENTS. Proposed amendments to an approved mining permit or reclamation plan may be submitted to the County at any time, detailing proposed changes from the original plan. Deviations from the original plan shall not be undertaken until such amendment has been filed with, and approved by, the County. Amendment applications shall be administratively processed pursuant to Sections 26A-4 and 26A-5 unless the Director determines that such amendments are minor in nature, in which case he may grant approval.

SECTION 26A-12 PERIODIC REVIEW

a) PERIODIC REVIEW. As a condition of approval for permits and reclamation plans, based upon the recommendation of the Committee, the Board of Zoning Adjustments or the Hearing Officer shall establish a monitoring program for and a schedule of periodic inspections of the site to evaluate continuing compliance with the permit and the reclamation plan.

- i) Each surface mining permit and reclamation plan shall contain a condition requiring periodic inspections and reports of mining and reclamation activities as follows:
 - 1) The operator shall notify the Director annually on the date specified in the reclamation or mining plan, and also at least fifteen (15) days before the conclusion of each stage of reclamation. The notice shall include a written report which specifies how the mining and/or reclamation of the site conforms to or deviates from the permit and/or reclamation plan.

- 2) The Director shall inspect the site within thirty (30) days of receipt of the written report from the operator. Failure to inspect within thirty (30) days shall be deemed acceptance of the report and compliance with the permit and/or reclamation plan.
- 3) Each operator shall furnish to the Division of Mines and Geology of the State of California, in the manner specified by the Agency, an annual report of the amount of minerals mined at each mining site.

SECTION 26A-13 FEES

a) FEES. The Board of Supervisors by resolution shall establish fees for the processing of mining permits, reclamation plans, vested right determinations, and for inspection of mining operations or for modification of any mining permits or reclamation plans.

- i) Processing fees shall be paid at the time of filing for a permit or plan approval. Annual inspection fees shall be paid prior to required annual inspections.

SECTION 26A-14 OPERATIONS ENFORCEMENT

a) INSPECTION. Upon receipt of the operator's report described above in Section 26A-12 and at any other reasonable time the Director may elect, he shall cause the permit areas to be inspected to determine if the operator has complied with the conditions of the permit and with the reclamation plan. The Director shall thereupon make a report to the Planning Commission. Any deficiencies noted in any inspection by the Director shall be reported promptly in writing to the operator and the Planning Commission. Following any such written notice, the operator shall rectify these deficiencies and shall diligently proceed until the deficiencies are corrected. Within ten days after receipt of the report from the Director, the operator may appeal the decision to the Planning Commission. The Planning Commission shall hold a hearing thereon within thirty (30) days after notice to the operator and the owner of the land, pursuant to Sections 26-207 and 26-207.2 of this Code. Board action is appealable pursuant to Section 26-208 of the Code. The Director may, upon making finding of public danger or emergency, or threat to life or property, require the operator to stop work for up to seventy-two (72) hours.

b) CORRECTION OF DEFICIENCIES. If operations under the permit are not proceeding in accordance with the permit and the operator has not commenced action to rectify deficiencies within thirty (30) days after notification by the Director, or if reclamation is not properly and timely carried out in conformance with said plan, the Director is authorized to take such actions by contract or otherwise as are necessary for the correction of such deficiencies unless an appeal is pending.

c) EXPENSES. The Director shall keep a record of all necessary expenses in carrying out any such project or activity, including a reasonable charge for the services performed by County personnel and equipment and for any materials used therefor.

d) LIABILITY. The Director shall notify the operator and his surety by order stating the amount of necessary expense incurred in correcting the deficiencies and a notice that the amount is due and payable to the County by the operator and the surety. If the amount specified in the order is not paid within thirty (30) days after receipt of the notice, the County may bring an action in a court of competent jurisdiction to collect the amount. The surety shall be liable to the County to the extent of the bond. Any additional amount owed to the County shall be recovered by claim against the operator or the property owner and shall be a lien on the land upon which operations are being conducted.

e) REVOCATION. In addition to other liabilities and remedies provided by law, failure to commence action to rectify deficiencies within thirty (30) days after notification by the Director or failure to complete reclamation satisfactorily and timely on any segment of the permit area in conformance with the reclamation plan therefor shall constitute sufficient grounds for revocation of a permit and refusal to issue another permit to the delinquent operator until such deficiencies are corrected.

SECTION 26A-15 RESPONSIBILITY

a) RESPONSIBILITY. The permittee, operator, property owner, their authorized agents, or any other person in control of the operation, individually or collectively, shall be responsible for the observation and compliance with all the provisions of this chapter. Such responsibility shall include the correction of any unsafe condition and the construction and maintenance of all fences and other protective devices required by the approved permit and/or reclamation plan.

SECTION 26A-16 PUBLIC RECORD

a) IDENTIFICATION OF PROPRIETARY INFORMATION. Reclamation plans, reports, applications and other documents submitted pursuant to this chapter are public records, unless it can be demonstrated to the satisfaction of the County that the release of such information, or part thereof, would reveal production, reserves or rate of depletion entitled to protection as proprietary information. The County shall identify such proprietary information as a separate part of each application. A copy of all permits, reclamation plans, reports, applications and other documents submitted pursuant to this chapter, including proprietary information, shall be furnished to the State Geologist by the County of Sonoma.

b) PROTECTION OF PROPRIETARY INFORMATION. Prior to the submittal of any proprietary information, the Board of Supervisors shall adopt clearly defined rules and procedures which will protect the private nature of that information from any unauthorized scrutiny. The rules and procedures shall include, but not be limited to, such items as: a listing of the specific categories of information which will be required from all operators equally; the uses to which the information is to be applied; the manner and place in which the information is to be stored, as well as all other security methods required to prevent unauthorized scrutiny of the information; the specific County representative who will be permitted to examine or use the information; the person responsible for enforcing the rules and procedures; and any other items necessary to provide protection. Proprietary information shall be made available to persons other than the State Geologist only when authorized by the mine operator and by the mine owner in accordance with the State Act.

SECTION 26A-17 SEPARABILITY

a) SEPARABILITY. If any section, subsection, sentence, clause or phrase of this ordinance is for any reason held to be invalid or unconstitutional by the decision of a court of competent jurisdiction, it shall not affect the remaining portions of the ordinance.

ALL HARDROCK OPERATIONS

INITIAL STUDY CHECKLIST

Planner _____

File No. _____

Date _____

Consistent _____ Inconsistent _____

1.a. General Plan

- (1) Land Use Plan
- (2) Open Space Plan
- (3) Goals and Policies

_____	_____
_____	_____
_____	_____

1.b. Specific Plan _____

_____	_____
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1.c. City of _____ General Plan

_____	_____
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<u>Yes</u>	<u>Maybe</u>	<u>No</u>
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2. Earth. Will the proposal result in significant:

- | | | | |
|--|----------|----------|----------|
| a. Unstable earth conditions or in changes in geologic substructures? | _____ | <u>X</u> | _____ |
| b. Disruption, displacements, compaction or overcovering of the soil? | <u>X</u> | _____ | _____ |
| c. Change in topography or ground surface relief features? | <u>X</u> | _____ | _____ |
| d. Removal of prime soils from potential agricultural production? | _____ | _____ | _____ |
| e. Increase in water erosion of soils, either on or off the site? | _____ | <u>X</u> | _____ |
| f. Changes in deposition or erosion of beach sands? | _____ | _____ | <u>X</u> |
| g. Changes in deposition or erosion which may modify the channel of a river or stream or the bed of the ocean or any bay, inlet or lake? | _____ | _____ | <u>X</u> |
| h. Exposure of people or property to earthquake hazards? | _____ | _____ | <u>X</u> |
| i. Exposure of people or property to landslide or mudslide hazards? | _____ | _____ | <u>X</u> |
| j. Exposure of people or property to ground failure or liquefaction hazards? | _____ | _____ | <u>X</u> |

⊗ AN "X" WITH A CIRCLE AROUND IT INDICATES AN IMPACT WHICH OCCURS OR MIGHT OCCUR AT AN INDIVIDUAL QUARRY OPERATION BUT DOES NOT OCCUR AT ALL OPERATION SITES.

	YES	MAYBE	NO
3. <u>Air</u> . Will the proposal result in:			
a. Substantial air emissions?	X	—	—
*b. Deterioration of ambient air quality?	—	X	—
c. The creation of objectionable odors?	—	—	X
d. Alteration of air movement, moisture, or temperature, or any change in climate, either locally or regionally?	—	—	X
4. <u>Water</u> . Will the proposal result in:			
a. Changes in currents, or the course or direction of water movements, in either marine or fresh waters?	—	—	X
b. Changes in absorption rates in an aquifer recharge area?	—	⊗	—
c. Changes in drainage patterns?	X	—	—
d. Changes in the amount or rate of surface water runoff?	—	X	—
e. Alterations to the course or flow of flood waters?	—	—	X
f. Change in the amount of surface water or stream flow in any water body?	—	—	X
g. Discharge of any wastes into surface waters?	—	—	X
h. Any alteration of surface water quality, including temperature, dissolved oxygen, or turbidity?	—	⊗	—
i. Change in the quantity of groundwaters through direct withdrawals?	—	⊗	—
j. Change in the quality of groundwaters, either through direct additions or withdrawals?	—	—	X
k. Substantial reduction in the amount of water otherwise available for public water supplies?	—	—	X
l. Exposure of people or property to flooding?	—	—	X
m. Exposure of people or property to tidal waves?	—	—	X
5. <u>Plant Life</u> . Will the proposal result in:			
a. Removal of any trees?	—	X	—
b. Destruction of more than ten acres of grassland?	—	X	—
c. Removal of more than one acre of brush and shrubs?	X	—	—
d. Significant reduction of the numbers of any unique, rare or endangered species of plants?	—	—	X
e. Significant reduction in extent of any unique biotic habitat (i.e., riparian, marshes, estuaries, beaches, vernal pools)?	—	—	X

	YES	MAYBE	NO
f. Planting of non-native trees and shrubs in excess of one acre?	—	—	X
*g. Reduction in acreage of orchard, vineyard, or other intensive agricultural uses, in excess of one acre?	—	—	X
*h. Reduction in acreage of grazing land or other extensive agricultural uses, in excess of ten acres?	—	⊗	—
6. <u>Animal Life</u> . Will the proposal result in:			
a. Significant reduction in the extent of any unique wildlife habitat such as marshes, estuaries, beaches, riparian corridors, or ecotones?	—	—	X
b. Significant reduction of the numbers of any unique, rare or endangered species of animals?	—	—	X
*c. Introduction of new species of animals into a non-urban area?	—	—	X
d. Creation of a barrier to the migration or movement of animals?	—	X	—
e. Deterioration to existing fish or wildlife habitat?	—	X	—
7. <u>Noise</u> . Will the proposal result in significant:			
*a. Increases in existing day noise levels?	X	—	—
*b. Increases in existing night noise levels?	—	X	—
*c. Exposure of people to severe noise levels?	—	⊗	—
8. <u>Light and Glare</u> . Will the proposal produce a significant amount of new light and glare?	—	—	X
9. <u>Natural Resources</u> . Will the proposal result in:			
*a. Increase of rate of use of any natural resource?	X	—	—
*b. Substantial depletion of any non-renewable natural resource?	—	—	X
10. <u>Risk of Upset</u> . Does the proposal involve a risk of an explosion or the release of hazardous substances (including, but not limited to, oil, pesticides, chemicals or radiation) in the event of an accident or upset conditions?	—	⊗	—
*11. Will the proposal have significant growth-inducing impacts?	—	—	X
12. Will the proposal result in a reduction of the existing housing stock?	—	—	X

	YES	MAYBE	NO
13. <u>Transportation/Circulation</u> . Will the proposal result in:			
a. Generation of substantial additional vehicular movement?	X	—	—
b. Effects on existing parking facilities, or demand for new parking?	—	—	X
c. Substantial impact upon existing transportation systems?	—	—	X
d. Alterations to present patterns of circulation or movement of people and/or goods?	—	—	X
e. Alterations to waterborne, rail or air traffic?	—	—	X
f. Increase in traffic hazards to motor vehicles, bicyclists or pedestrians?	—	X	—
g. A need for additional access?	—	—	X
h. Need for maintenance or improvement of existing public roads?	—	X	—
i. Construction of new public roads?	—	—	X
14. <u>Public Services</u> . Will the proposal have an effect upon, or result in a need for new or altered governmental services in any of the following areas:			
*a. Fire protection?	—	—	X
*b. Police protection?	—	X	—
*c. Schools?	—	—	X
*d. Parks or other recreational facilities?	—	—	X
*e. Other governmental services?	—	—	X
*15. <u>Energy</u> . Will the proposal result in use of substantial amounts of fuel or energy?	X	—	—
16. <u>Utilities</u> . Will the proposal result in a need for new public systems, or substantial alterations to the following utilities:			
*a. Power or natural gas?	—	—	X
*b. Communications systems?	—	—	X
c. Water?	—	—	X
d. Sewer?	—	—	X
e. Storm water drainage?	—	—	X
f. Solid waste and disposal?	—	—	X

	<u>YES</u>	<u>MAYBE</u>	<u>NO</u>
17. <u>Human Health.</u> Will the proposal result in:			
a. Creation of any health hazard or potential health hazard?	—	X	—
b. Creation of a new septic tank system?	—	—	X
c. Exposure of people to existing potential health hazards?	—	—	X
18. <u>Aesthetics.</u>			
*a. Will the proposal result in the obstruction of any scenic vista or view open to the public in a designated Scenic Area or Community Separator?	—	—	X
*b. Will the proposal result in the creation of an aesthetically offensive site open to public view?	—	X	—
*19. <u>Recreation.</u> Will the proposal result in an impact upon the quality or quantity of existing recreational opportunities?	—	⊗	—
20. <u>Archaeological/Historical.</u> Will the proposal result in:			
a. An alteration of a significant archaeological site?	—	X	—
b. An alteration of a significant historical site, structure, object or building?	—	—	X
21. <u>Mandatory Findings of Significance.</u>			
a. Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	—	X	—
b. Does the project have the potential to achieve short-term, to the disadvantage of long-term, environmental goals? (A short-term impact on the environment is one which occurs in a relatively brief, definitive period of time while long-term impacts will endure well into the future.)	X	—	—
c. Does the project have impacts which are individually limited, but cumulatively considerable? (A project may impact on two or more separate resources where the impact on each resource is relatively small, but where the effect of the total of these impacts on the environment is significant.)	—	X	—
d. Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	X	—	—

TERRACE OPERATIONS

INITIAL STUDY CHECKLIST

Planner _____

File No. _____

Date _____

Consistent Inconsistent

1.a. General Plan

- (1) Land Use Plan
- (2) Open Space Plan
- (3) Goals and Policies

1.b. Specific Plan _____

1.c. City of _____ General Plan

Yes Maybe No

2. Earth. Will the proposal result in significant:

- a. Unstable earth conditions or in changes in geologic substructures?
- b. Disruption, displacements, compaction or overcovering of the soil?
- c. Change in topography or ground surface relief features?
- d. Removal of prime soils from potential agricultural production?
- e. Increase in water erosion of soils, either on or off the site?
- f. Changes in deposition or erosion of beach sands?
- g. Changes in deposition or erosion which may modify the channel of a river or stream or the bed of the ocean or any bay, inlet or lake?
- h. Exposure of people or property to earthquake hazards?
- i. Exposure of people or property to landslide or mudslide hazards?
- j. Exposure of people or property to ground failure or liquefaction hazards?

X — —
X — —
X — —
— X —
— X —
— — X
— X —
— — X
— — X
— — X

	YES	MAYBE	NO
3. <u>Air</u> . Will the proposal result in:			
a. Substantial air emissions?	X	—	—
*b. Deterioration of ambient air quality?	—	X	—
c. The creation of objectionable odors?	—	—	X
d. Alteration of air movement, moisture, or temperature, or any change in climate, either locally or regionally?	—	—	X
4. <u>Water</u> . Will the proposal result in:			
a. Changes in currents, or the course or direction of water movements, in either marine or fresh waters?	—	X	—
b. Changes in absorption rates in an aquifer recharge area?	—	X	—
c. Changes in drainage patterns?	X	—	—
d. Changes in the amount or rate of surface water runoff?	—	—	X
e. Alterations to the course or flow of flood waters?	—	X	—
f. Change in the amount of surface water or stream flow in any water body?	—	—	X
g. Discharge of any wastes into surface waters?	—	X	—
h. Any alteration of surface water quality, including temperature, dissolved oxygen, or turbidity?	—	—	X
i. Change in the quantity of groundwaters through direct withdrawals?	—	X	—
j. Change in the quality of groundwaters, either through direct additions or withdrawals?	—	X	—
k. Substantial reduction in the amount of water otherwise available for public water supplies?	—	—	X
l. Exposure of people or property to flooding?	—	—	X
m. Exposure of people or property to tidal waves?	—	—	X
5. <u>Plant Life</u> . Will the proposal result in:			
a. Removal of any trees?	—	X	—
b. Destruction of more than ten acres of grassland?	—	—	X
c. Removal of more than one acre of brush and shrubs?	—	—	X
d. Significant reduction of the numbers of any unique, rare or endangered species of plants?	—	—	X
e. Significant reduction in extent of any unique biotic habitat (i.e., riparian, marshes, estuaries, beaches, vernal pools)?	—	X	—

	YES	MAYBE	NO
f. Planting of non-native trees and shrubs in excess of one acre?	—	—	X
*g. Reduction in acreage of orchard, vineyard, or other intensive agricultural uses, in excess of one acre?	—	X	—
*h. Reduction in acreage of grazing land or other extensive agricultural uses, in excess of ten acres?	—	—	X
6. <u>Animal Life</u> . Will the proposal result in:			
a. Significant reduction in the extent of any unique wildlife habitat such as marshes, estuaries, beaches, riparian corridors, or ecotones?	—	X	—
b. Significant reduction of the numbers of any unique, rare or endangered species of animals?	—	—	X
*c. Introduction of new species of animals into a non-urban area?	—	—	X
d. Creation of a barrier to the migration or movement of animals?	—	X	—
e. Deterioration to existing fish or wildlife habitat?	—	X	—
7. <u>Noise</u> . Will the proposal result in significant:			
*a. Increases in existing day noise levels?	X	—	—
*b. Increases in existing night noise levels?	—	X	—
*c. Exposure of people to severe noise levels?	—	—	X
8. <u>Light and Glare</u> . Will the proposal produce a significant amount of new light and glare?	—	—	X
9. <u>Natural Resources</u> . Will the proposal result in:			
*a. Increase of rate of use of any natural resource?	X	—	—
*b. Substantial depletion of any non-renewable natural resource?	—	X	—
10. <u>Risk of Upset</u> . Does the proposal involve a risk of an explosion or the release of hazardous substances (including, but not limited to, oil, pesticides, chemicals or radiation) in the event of an accident or upset conditions?	—	—	X
*11. Will the proposal have significant growth-inducing impacts?	—	—	X
12. Will the proposal result in a reduction of the existing housing stock?	—	—	X

	YES	MAYBE	NO
13. <u>Transportation/Circulation.</u> Will the proposal result in:			
a. Generation of substantial additional vehicular movement?	<u>X</u>	—	—
b. Effects on existing parking facilities, or demand for new parking?	—	—	<u>X</u>
c. Substantial impact upon existing transportation systems?	—	—	<u>X</u>
d. Alterations to present patterns of circulation or movement of people and/or goods?	—	—	<u>X</u>
e. Alterations to waterborne, rail or air traffic?	—	—	<u>X</u>
f. Increase in traffic hazards to motor vehicles, bicyclists or pedestrians?	—	<u>X</u>	—
g. A need for additional access?	—	—	<u>X</u>
h. Need for maintenance or improvement of existing public roads?	—	<u>X</u>	—
i. Construction of new public roads?	—	—	<u>X</u>
14. <u>Public Services.</u> Will the proposal have an effect upon, or result in a need for new or altered governmental services in any of the following areas:			
*a. Fire protection?	—	—	<u>X</u>
*b. Police protection?	—	<u>X</u>	—
*c. Schools?	—	—	<u>X</u>
*d. Parks or other recreational facilities?	—	—	<u>X</u>
*e. Other governmental services?	—	—	<u>X</u>
*15. <u>Energy.</u> Will the proposal result in use of substantial amounts of fuel or energy?	<u>X</u>	—	—
16. <u>Utilities.</u> Will the proposal result in a need for new public systems, or substantial alterations to the following utilities:			
*a. Power or natural gas?	—	—	<u>X</u>
*b. Communications systems?	—	—	<u>X</u>
c. Water?	—	—	<u>X</u>
d. Sewer?	—	—	<u>X</u>
e. Storm water drainage?	—	—	<u>X</u>
f. Solid waste and disposal?	—	—	<u>X</u>

YES MAYBE NO

17. Human Health. Will the proposal result in:

- | | | | |
|--|---|----------|----------|
| a. Creation of any health hazard or potential health hazard? | — | <u>X</u> | — |
| b. Creation of a new septic tank system? | — | — | <u>X</u> |
| c. Exposure of people to existing potential health hazards? | — | — | <u>X</u> |

18. Aesthetics.

- | | | | |
|--|---|----------|----------|
| *a. Will the proposal result in the obstruction of any scenic vista or view open to the public in a designated Scenic Area or Community Separator? | — | — | <u>X</u> |
| *b. Will the proposal result in the creation of an aesthetically offensive site open to public view? | — | <u>X</u> | — |

*19. Recreation. Will the proposal result in an impact upon the quality or quantity of existing recreational opportunities?

—	<u>X</u>	—
---	----------	---

20. Archaeological/Historical. Will the proposal result in:

- | | | | |
|---|---|----------|----------|
| a. An alteration of a significant archaeological site? | — | <u>X</u> | — |
| b. An alteration of a significant historical site, structure, object or building? | — | — | <u>X</u> |

21. Mandatory Findings of Significance.

- | | | | |
|--|----------|---|---|
| a. Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory? | <u>X</u> | — | — |
| b. Does the project have the potential to achieve short-term, to the disadvantage of long-term, environmental goals? (A short-term impact on the environment is one which occurs in a relatively brief, definitive period of time while long-term impacts will endure well into the future.) | <u>X</u> | — | — |
| c. Does the project have impacts which are individually limited, but cumulatively considerable? (A project may impact on two or more separate resources where the impact on each resource is relatively small, but where the effect of the total of these impacts on the environment is significant.) | <u>X</u> | — | — |
| d. Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly? | <u>X</u> | — | — |

INITIAL STUDY CHECKLIST

File No. _____

Date _____

Consistent	Inconsistent
1. <u>Consistent</u> 2. <u>Consistent</u> 3. <u>Consistent</u> 4. <u>Consistent</u> 5. <u>Consistent</u> 6. <u>Consistent</u> 7. <u>Consistent</u> 8. <u>Consistent</u> 9. <u>Consistent</u> 10. <u>Consistent</u> 11. <u>Consistent</u> 12. <u>Consistent</u> 13. <u>Consistent</u> 14. <u>Consistent</u> 15. <u>Consistent</u> 16. <u>Consistent</u> 17. <u>Consistent</u> 18. <u>Consistent</u> 19. <u>Consistent</u> 20. <u>Consistent</u> 21. <u>Consistent</u> 22. <u>Consistent</u> 23. <u>Consistent</u> 24. <u>Consistent</u> 25. <u>Consistent</u> 26. <u>Consistent</u> 27. <u>Consistent</u> 28. <u>Consistent</u> 29. <u>Consistent</u> 30. <u>Consistent</u> 31. <u>Consistent</u> 32. <u>Consistent</u> 33. <u>Consistent</u> 34. <u>Consistent</u> 35. <u>Consistent</u> 36. <u>Consistent</u> 37. <u>Consistent</u> 38. <u>Consistent</u> 39. <u>Consistent</u> 40. <u>Consistent</u> 41. <u>Consistent</u> 42. <u>Consistent</u> 43. <u>Consistent</u> 44. <u>Consistent</u> 45. <u>Consistent</u> 46. <u>Consistent</u> 47. <u>Consistent</u> 48. <u>Consistent</u> 49. <u>Consistent</u> 50. <u>Consistent</u> 51. <u>Consistent</u> 52. <u>Consistent</u> 53. <u>Consistent</u> 54. <u>Consistent</u> 55. <u>Consistent</u> 56. <u>Consistent</u> 57. <u>Consistent</u> 58. <u>Consistent</u> 59. <u>Consistent</u> 60. <u>Consistent</u> 61. <u>Consistent</u> 62. <u>Consistent</u> 63. <u>Consistent</u> 64. <u>Consistent</u> 65. <u>Consistent</u> 66. <u>Consistent</u> 67. <u>Consistent</u> 68. <u>Consistent</u> 69. <u>Consistent</u> 70. <u>Consistent</u> 71. <u>Consistent</u> 72. <u>Consistent</u> 73. <u>Consistent</u> 74. <u>Consistent</u> 75. <u>Consistent</u> 76. <u>Consistent</u> 77. <u>Consistent</u> 78. <u>Consistent</u> 79. <u>Consistent</u> 80. <u>Consistent</u> 81. <u>Consistent</u> 82. <u>Consistent</u> 83. <u>Consistent</u> 84. <u>Consistent</u> 85. <u>Consistent</u> 86. <u>Consistent</u> 87. <u>Consistent</u> 88. <u>Consistent</u> 89. <u>Consistent</u> 90. <u>Consistent</u> 91. <u>Consistent</u> 92. <u>Consistent</u> 93. <u>Consistent</u> 94. <u>Consistent</u> 95. <u>Consistent</u> 96. <u>Consistent</u> 97. <u>Consistent</u> 98. <u>Consistent</u> 99. <u>Consistent</u> 100. <u>Consistent</u>	1. <u>Inconsistent</u> 2. <u>Inconsistent</u> 3. <u>Inconsistent</u> 4. <u>Inconsistent</u> 5. <u>Inconsistent</u> 6. <u>Inconsistent</u> 7. <u>Inconsistent</u> 8. <u>Inconsistent</u> 9. <u>Inconsistent</u> 10. <u>Inconsistent</u> 11. <u>Inconsistent</u> 12. <u>Inconsistent</u> 13. <u>Inconsistent</u> 14. <u>Inconsistent</u> 15. <u>Inconsistent</u> 16. <u>Inconsistent</u> 17. <u>Inconsistent</u> 18. <u>Inconsistent</u> 19. <u>Inconsistent</u> 20. <u>Inconsistent</u> 21. <u>Inconsistent</u> 22. <u>Inconsistent</u> 23. <u>Inconsistent</u> 24. <u>Inconsistent</u> 25. <u>Inconsistent</u> 26. <u>Inconsistent</u> 27. <u>Inconsistent</u> 28. <u>Inconsistent</u> 29. <u>Inconsistent</u> 30. <u>Inconsistent</u> 31. <u>Inconsistent</u> 32. <u>Inconsistent</u> 33. <u>Inconsistent</u> 34. <u>Inconsistent</u> 35. <u>Inconsistent</u> 36. <u>Inconsistent</u> 37. <u>Inconsistent</u> 38. <u>Inconsistent</u> 39. <u>Inconsistent</u> 40. <u>Inconsistent</u> 41. <u>Inconsistent</u> 42. <u>Inconsistent</u> 43. <u>Inconsistent</u> 44. <u>Inconsistent</u> 45. <u>Inconsistent</u> 46. <u>Inconsistent</u> 47. <u>Inconsistent</u> 48. <u>Inconsistent</u> 49. <u>Inconsistent</u> 50. <u>Inconsistent</u> 51. <u>Inconsistent</u> 52. <u>Inconsistent</u> 53. <u>Inconsistent</u> 54. <u>Inconsistent</u> 55. <u>Inconsistent</u> 56. <u>Inconsistent</u> 57. <u>Inconsistent</u> 58. <u>Inconsistent</u> 59. <u>Inconsistent</u> 60. <u>Inconsistent</u> 61. <u>Inconsistent</u> 62. <u>Inconsistent</u> 63. <u>Inconsistent</u> 64. <u>Inconsistent</u> 65. <u>Inconsistent</u> 66. <u>Inconsistent</u> 67. <u>Inconsistent</u> 68. <u>Inconsistent</u> 69. <u>Inconsistent</u> 70. <u>Inconsistent</u> 71. <u>Inconsistent</u> 72. <u>Inconsistent</u> 73. <u>Inconsistent</u> 74. <u>Inconsistent</u> 75. <u>Inconsistent</u> 76. <u>Inconsistent</u> 77. <u>Inconsistent</u> 78. <u>Inconsistent</u> 79. <u>Inconsistent</u> 80. <u>Inconsistent</u> 81. <u>Inconsistent</u> 82. <u>Inconsistent</u> 83. <u>Inconsistent</u> 84. <u>Inconsistent</u> 85. <u>Inconsistent</u> 86. <u>Inconsistent</u> 87. <u>Inconsistent</u> 88. <u>Inconsistent</u> 89. <u>Inconsistent</u> 90. <u>Inconsistent</u> 91. <u>Inconsistent</u> 92. <u>Inconsistent</u> 93. <u>Inconsistent</u> 94. <u>Inconsistent</u> 95. <u>Inconsistent</u> 96. <u>Inconsistent</u> 97. <u>Inconsistent</u> 98. <u>Inconsistent</u> 99. <u>Inconsistent</u> 100. <u>Inconsistent</u>

- (1) Land Use Plan
- (2) Open Space Plan
- (3) Goals and Policies

1.b. Specific Plan

1.c. City of General Plan

Yes Maybe No

- a. Unstable earth conditions or in changes in geologic substructures?
- b. Disruption, displacements, compaction or overcovering of the soil?
- c. Change in topography or ground surface relief features?
- d. Removal of prime soils from potential agricultural production?
- e. Increase in water erosion of soils, either on or off the site?
- f. Changes in deposition or erosion of beach sands?
- g. Changes in deposition or erosion which may modify the channel of a river or stream or the bed of the ocean or any bay, inlet or lake?
- h. Exposure of people or property to earthquake hazards?
- i. Exposure of people or property to landslide or mudslide hazards?
- j. Exposure of people or property to ground failure or liquefaction hazards?

	<u>YES</u>	<u>MAYBE</u>	<u>NO</u>
3. <u>Air</u> . Will the proposal result in:			
a. Substantial air emissions?	<u>X</u>	<u>—</u>	<u>—</u>
*b. Deterioration of ambient air quality?	<u>—</u>	<u>X</u>	<u>—</u>
c. The creation of objectionable odors?	<u>—</u>	<u>—</u>	<u>X</u>
d. Alteration of air movement, moisture, or temperature, or any change in climate, either locally or regionally?	<u>—</u>	<u>—</u>	<u>X</u>
4. <u>Water</u> . Will the proposal result in:			
a. Changes in currents, or the course or direction of water movements, in either marine or fresh waters?	<u>—</u>	<u>X</u>	<u>—</u>
b. Changes in absorption rates in an aquifer recharge area?	<u>—</u>	<u>X</u>	<u>—</u>
c. Changes in drainage patterns?	<u>—</u>	<u>X</u>	<u>—</u>
d. Changes in the amount or rate of surface water runoff?	<u>—</u>	<u>—</u>	<u>X</u>
e. Alterations to the course or flow of flood waters?	<u>—</u>	<u>X</u>	<u>—</u>
f. Change in the amount of surface water or stream flow in any water body?	<u>—</u>	<u>—</u>	<u>X</u>
g. Discharge of any wastes into surface waters?	<u>—</u>	<u>X</u>	<u>—</u>
h. Any alteration of surface water quality, including temperature, dissolved oxygen, or turbidity?	<u>—</u>	<u>X</u>	<u>—</u>
i. Change in the quantity of groundwaters through direct withdrawals?	<u>—</u>	<u>X</u>	<u>—</u>
j. Change in the quality of groundwaters, either through direct additions or withdrawals?	<u>—</u>	<u>X</u>	<u>—</u>
k. Substantial reduction in the amount of water otherwise available for public water supplies?	<u>—</u>	<u>—</u>	<u>X</u>
l. Exposure of people or property to flooding?	<u>—</u>	<u>—</u>	<u>X</u>
m. Exposure of people or property to tidal waves?	<u>—</u>	<u>—</u>	<u>X</u>
5. <u>Plant Life</u> . Will the proposal result in:			
a. Removal of any trees?	<u>—</u>	<u>X</u>	<u>—</u>
b. Destruction of more than ten acres of grassland?	<u>—</u>	<u>—</u>	<u>X</u>
c. Removal of more than one acre of brush and shrubs?	<u>—</u>	<u>—</u>	<u>X</u>
d. Significant reduction of the numbers of any unique, rare or endangered species of plants?	<u>—</u>	<u>—</u>	<u>X</u>
e. Significant reduction in extent of any unique biotic habitat (i.e., riparian, marshes, estuaries, beaches, vernal pools)?	<u>—</u>	<u>X</u>	<u>—</u>

	YES	MAYBE	NO
f. Planting of non-native trees and shrubs in excess of one acre?	—	—	X
*g. Reduction in acreage of orchard, vineyard, or other intensive agricultural uses, in excess of one acre?	—	X	—
*h. Reduction in acreage of grazing land or other extensive agricultural uses, in excess of ten acres?	—	—	X
6. <u>Animal Life</u> . Will the proposal result in:			
a. Significant reduction in the extent of any unique wildlife habitat such as marshes, estuaries, beaches, riparian corridors, or ecotones?	—	X	—
b. Significant reduction of the numbers of any unique, rare or endangered species of animals?	—	—	X
*c. Introduction of new species of animals into a non-urban area?	—	—	X
d. Creation of a barrier to the migration or movement of animals?	—	X	—
e. Deterioration to existing fish or wildlife habitat?	—	X	—
7. <u>Noise</u> . Will the proposal result in significant:			
*a. Increases in existing day noise levels?	X	—	—
*b. Increases in existing night noise levels?	—	X	—
*c. Exposure of people to severe noise levels?	—	—	X
8. <u>Light and Glare</u> . Will the proposal produce a significant amount of new light and glare?	—	—	X
9. <u>Natural Resources</u> . Will the proposal result in:			
*a. Increase of rate of use of any natural resource?	X	—	—
*b. Substantial depletion of any non-renewable natural resource?	—	X	—
10. <u>Risk of Upset</u> . Does the proposal involve a risk of an explosion or the release of hazardous substances (including, but not limited to, oil, pesticides, chemicals or radiation) in the event of an accident or upset conditions?	—	—	X
* 11. Will the proposal have significant growth-inducing impacts?	—	—	X
12. Will the proposal result in a reduction of the existing housing stock?	—	—	X

	YES	MAYBE	NO
13. <u>Transportation/Circulation.</u> Will the proposal result in:			
a. Generation of substantial additional vehicular movement?	X	—	—
b. Effects on existing parking facilities, or demand for new parking?	—	—	X
c. Substantial impact upon existing transportation systems?	—	—	X
d. Alterations to present patterns of circulation or movement of people and/or goods?	—	—	X
e. Alterations to waterborne, rail or air traffic?	—	—	X
f. Increase in traffic hazards to motor vehicles, bicyclists or pedestrians?	—	X	—
g. A need for additional access?	—	X	—
h. Need for maintenance or improvement of existing public roads?	—	X	—
i. Construction of new public roads?	—	—	X
14. <u>Public Services.</u> Will the proposal have an effect upon, or result in a need for new or altered governmental services in any of the following areas:			
*a. Fire protection?	—	—	X
*b. Police protection?	—	—	X
*c. Schools?	—	—	X
*d. Parks or other recreational facilities?	—	—	X
*e. Other governmental services?	—	—	X
*15. <u>Energy.</u> Will the proposal result in use of substantial amounts of fuel or energy?	X	—	—
16. <u>Utilities.</u> Will the proposal result in a need for new public systems, or substantial alterations to the following utilities:			
*a. Power or natural gas?	—	—	X
*b. Communications systems?	—	—	X
c. Water?	—	—	X
d. Sewer?	—	—	X
e. Storm water drainage?	—	—	X
f. Solid waste and disposal?	—	—	X

	<u>YES</u>	<u>MAYBE</u>	<u>NO</u>
17. <u>Human Health.</u> Will the proposal result in:			
a. Creation of any health hazard or potential health hazard?	—	—	<u>X</u>
b. Creation of a new septic tank system?	—	—	<u>X</u>
c. Exposure of people to existing potential health hazards?	—	—	<u>X</u>
18. <u>Aesthetics.</u>			
*a. Will the proposal result in the obstruction of any scenic vista or view open to the public in a designated Scenic Area or Community Separator?	—	—	<u>X</u>
*b. Will the proposal result in the creation of an aesthetically offensive site open to public view?	—	<u>X</u>	—
*19. <u>Recreation.</u> Will the proposal result in an impact upon the quality or quantity of existing recreational opportunities?	—	<u>X</u>	—
20. <u>Archaeological/Historical.</u> Will the proposal result in:			
a. An alteration of a significant archaeological site?	—	—	<u>X</u>
b. An alteration of a significant historical site, structure, object or building?	—	—	<u>X</u>
21. <u>Mandatory Findings of Significance.</u>			
a. Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	<u>X</u>	—	—
b. Does the project have the potential to achieve short-term, to the disadvantage of long-term, environmental goals? (A short-term impact on the environment is one which occurs in a relatively brief, definitive period of time while long-term impacts will endure well into the future.)	<u>X</u>	—	—
c. Does the project have impacts which are individually limited, but cumulatively considerable? (A project may impact on two or more separate resources where the impact on each resource is relatively small, but where the effect of the total of these impacts on the environment is significant.)	<u>X</u>	—	—
d. Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	<u>X</u>	—	—

APPENDIX M

DATE: September 26, 1978
 TO: Board of Supervisors
 FROM: Pranab Chakrawarti, Planning Director
 SUBJECT: PROPOSED BUDGET AND FEE APPROPRIATION FOR AGGREGATE RESOURCE MANAGEMENT PLAN

In response to the direction of the Board of Supervisors Minute Order, Staff has prepared a work program and budget for the Aggregate Resource Management Study. It is proposed that the funds for this Study be advanced from reserves and re-captured as EIR fees from the industry over the next 24 months. Allocation of these costs to each operator is based on the size and type of the operation. Each operator will pay a share of only those parts of the Study benefiting his operation. Each task on the attached work program has been costed and allocated accordingly. The budget and cost allocation for each of the following five sections of the work program is shown on the following pages.

The preparation of this Study is in addition to those projects scheduled and funded for the Department for this year. A Contract Planner will be required for the 18-month period to conduct this work. This Planner, Mr. Gregory N. Carr, who has worked on this program as an intern, will be responsible for those planning tasks outlined in the work program and paid at the Planner II level.

Overall responsibility for study direction, coordination of technical consultants and liaison with industry and other agencies shall be handled by Staff Planner III, Ray Krauss.

BUDGET SUMMARY

I HYDROLOGY

A. County Planner - 8 wks. @ \$300.00/wk.	\$ 2,400.00	
B. Overhead	600.00	
C. Mapping Materials	325.00	
Total		\$ 3,325.00

II AGGREGATE SUPPLY

A. Consultant: Geology - Field: 22.5 wks. @ \$297.60/wk.		
Supervision: 2.5 wks. @ \$620.00/wk.		
Expenses: \$3,950.90	\$12,196.90	
B. Consultant: Mining Geology (to be hired)	2,000.00	
C. Laboratory Facilities	5,200.00	
D. Airphoto Reproduction	750.00	
E. County Planner - 15 wks. @ \$300.00/wk.	4,500.00	
F. Overhead	1,125.00	
G. Mapping Materials	225.00	
Total		25,996.90

III CONSERVATION

A. Consultants: Terrestrial			
Biology	- Field:	17 wks. @	
		\$297.60/wk.	
	Supervision:	2 wks. @	
		\$620.00/wk.	
	Expenses:	\$2,724.93	
Consultants: Fishery			
	- Field:	20 wks. @	
		\$297.60/wk.	
	Supervision:	2 wks. @	
		\$620.00/wk.	
	Expenses:	\$2,297.95	\$18,514.08
B. Airphoto Reproduction			250.00
C. County Planner - 12 wks. @ \$300.00/wk.			3,600.00
D. Overhead			900.00
E. Mapping Materials			225.00
	Total		\$23,489.08

IV LAND USE

A. County Planner - 16 wks. @ \$300.00/wk.		\$ 4,800.00	
B. Overhead		1,200.00	
C. Mapping Materials		225.00	
	Total		6,225.00

V MANAGEMENT PROCESS

A. Consultant: Hydrology - 20 days @ \$400.00/day (including expenses)		\$ 8,000.00	
B. Consultant: Terrestrial - 2 wks. @ \$620.00/wk.			
Biology and \$186.00 overhead			
Fishery		1,426.00	
C. County Planner - 27 wks. @ \$300.00/wk.		8,100.00	
D. Overhead		2,025.00	
E. Report Production		3,200.00	
	Total		22,751.00
	TOTAL BUDGET		\$81,786.98

I HYDROLOGY ISSUES

A. Consultant: Hydrology

The U. S. Army Corps of Engineers has offered to adjust the work program of the Corps' Russian River Basin Study in order to fulfill Sonoma County's requirements for this section of the Aggregate Resources Management Plan.

A. Consultant: Hydrology (continued)

Work program task Nos. 1, 2, 5-9 will be accomplished by George S. Nolte and Associates, hired and paid by the Corps, working closely with Sonoma County. This will save at least \$15-\$20,000 in the preparation of this Study.

B. Planner

1. Task Nos. 1, 2, 3, 4, 6 and mapping will be accomplished in a total of 8 weeks at a cost of	\$ 2,400.00
2. Department overhead and support costs	600.00
3. Mapping materials	<u>325.00</u>
TOTAL HYDROLOGY ISSUES	\$ 3,325.00

The fee for this section will be shared by terrace pit operators and instream operators according to the estimated lineal footage of each operation adjacent to the streambed. Fees to operators have been adjusted to reflect previous expenditures for Environmental Impact Reports which will be incorporated into this Study.

II AGGREGATE SUPPLY ISSUED

A. Consultant: Geology

Dr. Rolphe Erickson of the Geology Department of Sonoma State University will conduct an inventory of aggregate sources in Sonoma County. Task Nos. 17, 18 and 19 in the Aggregate Resource section of the work program will be accomplished by this arrangement at a cost of:

Field: 22.5 wks. @ \$297.60/wk.	
Supervision: 2.5 wks. @ \$620.00/wk.	
Expenses: \$3,944.90	\$12,196.90

B. Consultant: Mining Geology

A mining geologist yet to be selected will conduct an investigation of aggregate use specifications and processing requirements as outlined in task Nos. 24-27 at a maximum cost of 2,000.00

C. Laboratory Facilities (Materials Testing) 5,200.00

D. Airphoto Reproduction 750.00

E. Planner

1. Task Nos. 10-16, 20-28 and mapping will be accomplished in a total of 15 weeks at a cost of 4,500.00

E. Planner (continued)

2. Department overhead and support costs	\$ 1,125.00
3. Mapping Materials	<u>225.00</u>
TOTAL AGGREGATE SUPPLY ISSUES	\$25,996.90

The costs of this section will be shared by the quarry and terrace pit operators. The quarry operators will pay for one-half the total depending on the size of the operation (small, medium, large). The terrace pit operators will pay for the remaining one-half based on the amount of acreage being mined by each operation.

III CONSERVATION ISSUES

A. Consultants: Terrestrial Biology and Fishery

Dr. Robert Sherman, Dr. Philip Northen and Dr. John Hopkirk of the Biology Department at Sonoma State University will conduct an inventory and evaluation of vegetation, wildlife, and fishery resources in the Russian River Basin from Cloverdale to Wohler Bridge. Task Nos. 31-34 and 35-38 of the Conservation section of the work program will be accomplished at a cost of:

Terrestrial Biology

Field: 17 wks. @ \$297.60/wk.
Supervision: 2 wks. @ \$620.00/wk.
Expenses: \$2,724.93

Fishery

Field: 20 wks. @ \$297.60/wk.
Supervision: 2 wks. @ \$620.00/wk.
Expenses: \$2,298.95

\$18,514.08

B. Airphoto Reproduction 250.00C. County Planner

1. Task Nos. 29-31, 33, 35, 37, 39-45 and mapping will be accomplished in a total of 12 weeks at a cost of	3,600.00
2. Department overhead and support costs	900.00
3. Mapping materials	<u>225.00</u>
TOTAL CONSERVATION ISSUES	\$23,489.08

One-half of these costs will be shared by terrace pit operators according to the amount of acreage being mined and instream operators according to the lineal footage

III CONSERVATION ISSUES (continued)

affecting the streambed. The remaining one-half will also be shared by terrace pit and instream operators except that both will be assessed according to the lineal footage affecting the streambed. Again, some fees to operators have been adjusted to reflect expenditures for previous Environmental Impact Reports.

IV LAND USE ISSUES

A. County Planner

1. Task Nos. 46-56 and mapping will be accomplished in a total of 16 weeks at a cost of	\$ 4,800.00
2. Department overhead and support costs	1,200.00
3. Mapping materials	<u>225.00</u>
TOTAL LAND USE ISSUES	\$ 6,225.00

These costs will be shared by terrace pit and instream operators. One-half will be paid by terrace pit operators according to the amount of acreage being mined by each. The remaining one-half will be paid by instream operators according to the amount of lineal footage affecting the streambed.

V MANAGEMENT PROCESS

A. Consultant: Hydrology

Dr. David Storm of Storm Engineering will assist in overseeing the completion of Hydrology task Nos. 5-9 and Management task Nos. 57-61 at a maximum cost of: 20 days @ \$400.00/day

\$ 8,000.00

The cost of Dr. Storm's services will be funded under the same schedule as that used for Hydrology issues. The fees for some operators have been adjusted to reflect previous expenditures for Environmental Impact Reports which will be incorporated into this Study.

B. Consultant: Terrestrial Biology and Fishery

Dr. Robert Sherman, Dr. Philip Northen and Dr. John Hopkirk will assist in task Nos. 68-72 at a cost of: 2 wks. @ \$620.00/wk
Overhead: \$186.00

1,426.00

V MANAGEMENT PROCESS (continued)

C. County Planner

- | | |
|--|-------------|
| 1. Task Nos. 57-79 will be accomplished in a total of 27 weeks at a cost of: | \$ 8,100.00 |
| 2. Department overhead and support costs | 2,025.00 |

D. Report Production and Distribution 3,200.00

TOTAL MANAGEMENT PROCESS	\$22,751.00
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The remainder of the budget for the Management Process section will be shared by all operators according to the following schedule:

- 10% - Quarry operators by the relative size of each operation (small, medium, large)
- 45% - Terrace pit operators by the amount of acreage being mined by each operation
- 45% - Instream operators by the number of lineal feet of streambed affected by each operation

TYPICAL FEES NECESSARY TO BE CHARGED
TO EACH OPERATOR TO COVER STUDY COSTS

I QUARRIES *

A. Small: \$361.84 each

- | | |
|--------------------------|----------------------|
| 1. Ghilotti Bros. Pit | 6. Nun Canyon Quarry |
| 2. Green Valley Quarry | 7. Chenoweth Quarry |
| 3. Trinity Quarry | 8. Hagemann Quarry |
| 4. Cecil Inman Shale Pit | 9. Graham Quarry |
| 5. Brooks Quarry | 10. Cinnabar Quarry |

B. Medium: \$1,085.51 each

- | | |
|-----------------------|------------------------|
| 1. Sonoma Rock | 5. Mark West Shale Pit |
| 2. Stony Point Quarry | 6. Blue Rock Quarry |
| 3. Zamaroni Pit | 7. Canyon Rock |
| 4. Bloomfield Quarry | |

C. Large: \$3,256.58 each

1. Quarry Products, Inc.

TOTAL QUARRY	\$14,473.55
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*As Vested Rights forms are submitted, additional operations may be added to this list. Fees will be adjusted accordingly to reflect wider sharing of costs of study and to fund the additional required inventory work.

II TERRACE PITS **

A. Kaiser (Windsor Sand & Gravel)	\$21,819.38
B. Basalt Rock (Healdsburg)	11,700.55
C. MacMurray Enterprises	2,487.25
D. Quarry Products, Inc.	<u>3,114.25</u>
TOTAL TERRACE PIT	<u>\$39,121.43</u>

III INSTREAM ***

A. Basalt Rock (Geyserville, Jintown Bridge)	\$23,180.00
B. Piombo Corp.	-0-
C. Soiland Co. (Healdsburg Sand & Gravel)	1,560.00
D. H. B. Groom, Inc.	2,412.00
E. Cloverdale Readymix	1,040.00
F. Cavallo, Inc.	<u>-0-</u>
TOTAL INSTREAM	<u>\$28,192.00</u>
TOTAL A.R.M.S.	<u>\$81,786.98</u>

REK:GNC:vr

**Additional operations may be included in this category during the course of the Study. If so, they will be charged at a rate of \$61.13 per acre to cover added Study costs.

***Additional operations may be included in this category during the course of the Study. If so, they will be charged at a rate of \$0.38 per lineal foot abutting the streambed to cover added costs.

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